

INFLUENCES OF SITUATED COGNITION ON TRACHEAL INTUBATION SKILL
ACQUISITION IN PARAMEDIC EDUCATION

A Dissertation

by

LANCE CARLTON VILLERS

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

May 2008

Major Subject: Educational Human Resource Development

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ABSTRACT

Influences of Situated Cognition on Tracheal Intubation Skill Acquisition in Paramedic

Education. (May 2008)

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Situated cognition argues that learning takes place in an embedded social and physical environment, and through a social process, reality takes on meaning. This dissertation investigated if a link exists between learners' participation and advancement within a sociocultural community of practice as specifically evidenced by higher rates of tracheal intubations on live patients and scores on the national certifying examination by paramedics. During 2006, paramedic students taking the national certifying examination were asked to answer a post-examination questionnaire quantifying the number of intubations performed during training. For intubation experience, significant odds ratios (relative to none performed) were observed for 4 to 9 performed [OR = 1.66, 95% c.i. = (1.24, 2.23)] and 16 or more performed [OR = 1.76, 95% c.i. = (1.21, 2.56)]. The male to female odds ratio [OR = 1.25, 95% c.i. = (1.04, 1.52)] was significant. For age category, significant odds ratios (relative to 40 and over) were observed for 20 to 24 [OR = 1.70, 95% c.i. = (1.27, 2.28)] and 25 to 29 [OR = 1.32, 95% c.i. = (1.00, 1.73)]. For education, the bachelor's degree to high school odds ratio [OR = 2.56, 95% c.i. = (1.95, 3.35)] was significant. For ethnicity, significant odds ratios (relative to African-Americans) were observed for whites [OR = 1.69, 95% c.i. = (1.04, 2.74)] and others [OR = 2.33, 95% c.i. = (1.15, 4.72)]. The multivariable logistic regression model results suggest

that the number of tracheal intubations, sex, ethnicity and education level are all associated with greater odds of passing the certifying examination.

In addition to traditional classroom lectures and activities, paramedic students also learn in clinical situations with varying levels of supervision culminating in near independent practice. Theories of situated cognition provide insight into these clinical learning situations that break from traditional models. When context, content, and community merge, knowledge is generated in new and meaningful ways. By participating in communities of practice, knowledge is transferred, created, and altered along with the learner through active engagement with all the ill-structured, dynamic, and unpredicted opportunities the ‘real world’ offers. The students’ exposure to live tracheal intubations during training serve as an example of situated learning environments and its influence can be observed through the national certifying examination.

The findings provide guidance for paramedic educators in creating situative learning affordances and specifically, determining the number of tracheal intubations performed during paramedic training.

ACKNOWLEDGEMENTS

“...if you do follow your bliss you put yourself on a kind of track that has been there all the while, waiting for you, and the life that you ought to be living is the one you are living. When you can see that, you begin to meet people who are in the field of your bliss, and they open the doors to you. I say, follow your bliss and don't be afraid, and doors will open where you didn't know they were going to be.”

- Joseph Campbell

At the heart of academia are its educators, those select few who dedicate their lives to learning about the world, investigate phenomena, and most importantly, pass the torch of their knowledge and experiences to students. Thank you Dr. Carolyn Clark for your insight and patience; and Dr. Homer Tolson, Dr. Jennifer Sandlin, and Dr. C. Jane Welsh. I am privileged to stand under the illumination of the torches you carry. Thank you to the National Registry of EMTs for their assistance in providing and collecting the data used for my analysis.

It is argued that true educative experiences are transformative and to this point my experiences as doctoral student at Texas A&M have enabled me to forever see the world differently. I thank all the faculty and students, especially Joellen Coryell, who played a part in this transformation. The long drives, the philosophical discussions, and motivational support kept me on target and allowed this process to be mutually rewarding and personal.

The process of transformation often comes with a cost and graduate school is no exception. To my loving family who often went fatherless to baseball and football games, parent-teacher meetings, and had so many dinners with one empty chair. Thank you to my wife Debby Villers and my sons, Luke and Connor. Yes, dad is finished now. And finally a special thank you to my parents Carlton and Sally Villers, who so many years ago instilled in me a sense of the importance and value of education. Having parents who are English teachers taught me that mediocrity and trying less than one's best, is something I would not put with or, *up with which I would not put*. I am proud to share this accomplishment with all of you.

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CHAPTER I

INTRODUCTION

Oh my God. I was concentrating on drawing up the correct dose of epinephrine at the time. *Is the IV in?* I started to draw up one milligram of medication. Our patient was in cardiac arrest. Healthy by all accounts otherwise, until this morning when his heart stopped while working on an electrical panel. *Do you think he was electrocuted?* The same man who said those words told us earlier that he wasn't electrocuted. They were both here working together. They had set off together to perform their years-old ritual of getting the days assignments and driving in their worn and weathered work truck to the job site. *He just collapsed.* My partner had intubated him.

Is it in? I placed my stethoscope over his bared chest while my partner squeezed the bag to inflate his lungs with oxygen. *Yea. What about the stomach?* I placed my stethoscope over the stomach to confirm that the tracheal tube wasn't placed in his esophagus. *It's clear.* I'm starting to become aware now of the circle of onlookers. His friend is of course among them. Other coworkers nearby have now heard that John may have had a heart attack. Students on their way to class have stopped to observe the commotion on the concrete floor where my partner and I are kneeling. My partner and I work simultaneously. I placed the IV in his left hand. He adjusted the flow of fluid. I secured it with tape. He put the needle away. *Push the epi.* Epinephrine. Adrenaline. This would profoundly alter blood flow and dilate his lungs to bring in more oxygen. More oxygen!

This dissertation follows the format of the *Journal of Educational Psychology*.

Hook up the bag to O₂ tank. Now the hiss of the oxygen leaving the green metal tank feeding the bag only made the silence of the expanding crowd more noticeable. My partner was moving the cardiac monitor closer in and he slid the two paddles out of the top cradle raising them up to untangle the coiled wires. I reached in the side bag holding the cardiac monitor to grab the conducting gel. My partner turned the paddles over, one in each hand, exposing the cold metallic undersurface and like squirting toothpaste from a tube I squirted out a small glob of the clear liquid and he touched the two paddle surfaces together to spread it around. He placed the paddles on the man's chest. One on John's right chest just below his collar bone. The other on his left lower rib cage. His dying heart in the middle. My partner charged the defibrillator to 200 joules. The crowd is completely focused on our movements. I shuffled my body backwards slightly and look at my knees to make sure I'm not touching John. My eyes quickly scan him from head to toe to make sure that he's not in contact with anyone. My partner is leaning over the lifeless body. Arms extended holding the paddles with both thumbs ready to simultaneously press the discharge buttons on the paddles that will send a powerful electrical shock through John's body.

Clear? Clear. My partner pressed the discharge buttons and the defibrillator made a gentle click. The muscles in John's body immediately contracted. My eyes went to the screen of the cardiac monitor to look for a change in his heart rhythm. No change on the cardiac monitor. My partner repeated the defibrillation two more times as is the protocol. I moved towards John's head to intubate him. In my left hand was the cold, metallic laryngoscope. The intense white light illuminated the tip told me it was ready.

In my right hand was the tracheal tube extending from my hand like a curved conductor's baton. I placed the laryngoscope into his mouth carefully avoiding his teeth. The cold feel of his skin contrasted with the slight abrasiveness of the whiskers on his chin. As the tip of the laryngoscope eased over his tongue and went deeper into the back of his mouth, the pooled vomit immediately blocks my vision to the vocal cords. I retreated and grabbed the portable suction device and inserted the catheter tip back into his mouth to remove the vomit. As quickly as the vomitus was sucked out, more was coming up from his esophagus. The priority of controlling his airway became more and more panicked in my mind as I became conscious of how long he had not been breathing or with oxygen. With vomit in the airway comes the risk of aspirating the contents into the lungs and if John survived this initial insult, death could come days later from pneumonia or infection. I continued suctioning, I reattempted to intubate. My partner was administering medications, and repeated a defibrillation. A rhythm returned on the cardiac monitor but a pulse was hard to detect. We needed to get John into the ambulance and to the hospital. There was a circle of equipment, trash, wires, oxygen tanks, open kits and bags. We gathered up as best as we could, making sure we left as little evidence as possible, including used needles or bloody gauze. I had reverted back to ventilating him with a bag-valve mask and continued suctioning as best I could. I had a growing sense of failure knowing the importance of securing a tracheal tube. Squeezing the bag around his mouth was less efficient and the risk of aspiration was now a foregone conclusion.

Now the work transformed from the cold concrete floor with space to work to the back of a moving ambulance, lights flashing and siren blaring, travelling across town dodging drivers who are slow to hear or respond to our approach and entering red-lighted intersections cautiously. In the back of the ambulance, our work continues. We reconnect wires and tubes for transport. A pulse was felt, there is a heart rhythm on the monitor, but he is not breathing on his own. I remain on my knees even in the back of the ambulance to keep my center of gravity low as we take turns and bottom-out on the dips of road intersections. I return with the laryngoscope in my left hand and tracheal tube in my right. Hoping that something different will happen this time. I try again. And I can't get the tube in. I have to quit the attempts and fall back to another airway device. A tube that is blindly inserted into the mouth through the esophagus that is designed to redirect air into the trachea. It's not as effective. It's a clear sign that the tracheal intubation attempt has failed and I have to continue with other resuscitation concerns and contact the hospital.

John survived the night in the intensive care unit. He remained comatose for several days. He remained on a ventilator, was later transferred to an extended care nursing facility for several months and he eventually fully recovered. While survival from out-of-hospital cardiac arrest is rare, less than 10%, John's story could be called a successful resuscitation, literally back from the dead. But the delay in his recovery was likely due to the inability to secure a tracheal tube.

This event set a path for me that I continue almost 20 years later. It directed me to learn more, train harder, and be better prepared for the next medical event. As I

transitioned from practitioner to a teacher, I knew that I had to create situations that would best prepare my students for written tests and for real world events that would make the classroom seem like a safe haven from shock of reality. But I knew I had to minimize this shock by designing learning environments that mixed the required classroom experiences with learning in real world contexts. The more I prepared myself for teaching, the more I was called to immerse myself in learning theories that advanced the notion of learning from experience and learning from the contexts of community and practitioners.

Few events are more memorable than the ones that transform our professional course and impact our personal commitments. My encounter with John is memorable for the obvious reasons, but after an event like this I cannot help but reflect on what happened, on what I did, on what my partner did, and what was most striking to me as a new paramedic was the realization that this was nothing like what I read in the textbook or practiced in class. Twenty years later I can see this event clearly, while the classroom activities that prepared me to treat this patient are distant and hazy. My learning and knowing was structured by the interactions at this cardiac arrest scene, our interactions with each other, the bystanders, coworkers, the tools, the medications, the words spoken, and the actions taken. The textbook, my teachers, my classmates, the examinations I prepared for and the lectures I heard, all played an important part in my learning. Without this cognitive foundation, my experiences would be a hit-or-miss process of random patients and haphazard encounters. Patients, of course, do not come with a set of instructions and the knowledge of knowing what medication at what dose would never

fully become part of my professional practice. Tension develops between the balancing opportunities required to gain the cognitive, classroom knowledge required of any health care practitioner with the exposure to the hands-on, real-world experience needed to apply the knowledge and gain the practical experience required to become competent and confident.

The Present Study

This study represents a course of inquiry that started with my inability to insert a tracheal tube at the critical moment twenty years ago and to understand the balance between the classroom and the emergency scene, as I direct a university department of EMS education today. My research question, although focused and of singular purpose, it is designed to add a small piece of insight into the broader practice of paramedicine and to the art of teaching and learning within the emergency medical service profession. There is a redemptive feeling of success if a teacher is better able to convey curricula or a paramedic is better prepared to treat a patient because of my small contribution.

This document is organized into five chapters but it does not follow the traditional dissertation structure; instead I have written three articles based on this research, framed by an introduction and a conclusion. This introductory chapter frames my research by describing the seminal event that created the quest for understanding the role of experience and context in learning. I also include definitions of important terms for later chapters. Chapter II, is the first article and it introduces the theoretical underpinnings of experiential learning, learning within a community of practice and under cognitive apprenticeships. Chapter III is the article that presents the quantitative

study of investigating the link between learning the skill of tracheal intubation in context and performance on the national certifying examination for paramedics. Because my own experience had such a profound influence on me, I recognize the narrative and descriptive value that transcends statistical analyses. In Chapter IV, I have rafted an article that presents the coordinated value of adding qualitative studies with the quantitative research so prevalent in health care and medicine by describing and investigating mixed methods research. I conclude this paper in Chapter V by summarizing important findings of my research and discuss future directions for EMS research and practice.

Definitions

The following is a list of operationally defined terms:

1. *Emergency Medical Services (EMS)* – informally describes the matrix of fire departments, ambulance services, rescue squads, and public safety services that perform rescue and prehospital medical care, as well as transport to hospitals. The goal of EMS is to provide early treatment to those in need of urgent medical care.
2. *Emergency Medical Technician (EMT)* - is an emergency responder trained to provide emergency medical services to the critically ill and injured. EMTs are certified according to their level of training. The National Registry of Emergency Medical Technicians (NREMT), a voluntary standards and testing body, recognizes three levels of EMT: EMT-B (Basic), EMT-I (Intermediate), and EMT-P (Paramedic) in increasing levels of education and responsibility. EMT-B skills include CPR, first aid, airway management, oxygen administration, spinal immobilization, bleeding control and traction splinting.

The EMT-I varies across the states. In general the EMT-I includes instruction in inserting intravenous lines and limited advanced respiratory support. The EMT-Paramedic skills may include monitoring and interpreting electrocardiograms, inserting intravenous lines, initial cardiac drug therapy, advanced respiratory support and airway skills, pharmacology, advanced cardiopulmonary resuscitation, pediatric life support and advanced cardiac life support.

3. *Tracheal intubation (TI)* – is the insertion of a hollow tube into the trachea to ventilate the lungs. Tracheal intubation is performed in various medical conditions: comatose patients who are at risk of aspiration of secretions or foreign bodies; patients who are in cardiopulmonary arrest; patients who are unable to adequately breathe. The procedure uses a laryngoscope to view the glottis and an tracheal tube is placed into the opening. A ventilation device is attached to deliver oxygen and ‘breathes’ for the patient.

4. *National Registry of Emergency Medical Technicians (NREMT)* - is a voluntary standards and testing body whose purpose is to assess the knowledge and skills required for competent practice required by EMS professionals. Most states adopt the NREMT as the credentialing agency and will grant a license or state certification following a graduate’s successful completion of the NREMT examination process.

5. *Out-of-hospital* – (also *prehospital*) – refers to the environment in which EMS operates.

6. *US Department of Transportation* – is the federal agency that develops the National Standard Curriculum (NSC) for EMS education at all levels. All EMT training must

meet the minimum requirements as set forth in the educational objectives for the EMT (Basic through Paramedic) curriculum.

CHAPTER II

LEARNING OUTSIDE THE MIND: SITUATED COGNITION AND THE POWER OF CONTEXT IN THE HEALTH PROFESSIONS

Introduction

The story that I told in Chapter I of my first encounter with a patient in cardiac arrest illustrates the principle that experience and learning context are not just passing considerations but are central to understanding teaching and learning. In my paramedic training, I had learned the steps, the equipment, the medications, and the physiology in class but the authenticity of prehospital care comes from the interaction of the right steps with the very environment the classroom filters. Over time, as I gain more experience with these patients, handle the complexity of people, bystanders, physicians, nurses, co-workers, and use the tools of medical care, I learn to be a paramedic. While the classroom lays the foundation for learning, the social context in which my knowledge is applied and modified becomes the frame and structure for learning and successful transferability. Learning the knowledge, skills, and attitudes of prehospital emergency care in order to obtain clinical expertise is a complex phenomenon. Classroom teaching and skills practice have traditionally been used by teachers to bring students to levels of proficiency and mastery of the necessary and required skills within the domain of paramedical practice. Students traditionally master skills, procedures, and performance through repeated practice on mannequins and patients with varied levels of supervision. Unfortunately, high-stake professions such as those in healthcare face a tension. Society demands that graduates enter the workforce prepared to care for people at levels that

exceed minimal competency, yet practical and ethical concerns limit the degree to which students can ‘practice’ on patients in real-world contexts. But another pressing factor is that employers need graduates to fill vacant positions in the workforce quickly. These dilemmas of learning in health care are appropriately the focus of adult education research and investigation.

Constructivism, as an epistemology, argues that knowledge is the outcome of experience and framed by one’s own prior knowledge. Through a social process, reality takes on meaning. Knowledge is to be used, not acquired, and as a theory of learning, constructivism construes learning as an interpretive process, as a learner interacts with his or her social and physical milieu. The notion of the primacy of social interactions and processes is that of situated learning. Situated learning or cognition is a general theory of how knowledge and skills are acquired. In the situated learning approach, knowledge and skills are learned in everyday situations which therefore stress the sociocultural phenomenon of learning and minimizes the individual, decontextualized acquisition of knowledge. The purpose of this paper is to discuss the theoretical underpinnings of situated learning and the significance for learning in the health professions. Weaved through this paper are stories of some of my own learning experiences of transitioning from a new paramedic to a paramedic educator where I must design effective learning experiences for paramedic students at an academic health science center.

This chapter has three sections. First, I introduce the theory of situated learning, its formation within experiential learning theory and its break from traditional views of

learning that are cognitive in nature. The next section discusses the importance of context in creating authentic learning environments and learning transfer. In the last section, I discuss learning through cognitive apprenticeship, how expertise is developed, and implications of the situated learning model for teaching and learning in health care.

Learning Through Experience

In reflecting on my own process of becoming a paramedic, it is only natural that I recall those moments of experience outside the classroom. Kneeling in the muck, holding a hand, staring in disbelief, inhaling the odors, and feeling our own quickened heart rate as an emergency unfolds are part of our world as paramedics. The classroom seems a minor player in our professional development. Many times the classroom represents a hindrance to learning and we hear phrases like, “Just forget what you learned in class, this is the real world.” This learning-through-doing priority challenges more traditional, content-based forms of learning, which involve reading, writing, discussing, and listening. But it is clear that both traditional and experiential learning are essential in health care education. It is a question of balance, but it is also a question of the complex and multifaceted nature of the learning process itself. The challenge to the health care educator is to design learning experiences that prepare students for the complexities of real-world practice.

We learn in a variety of ways. In health care education, one can learn by reading and listening, from textbooks and teachers, and we can learn through experience. According to Fenwick (2003) experiential learning includes: field-based experience, credit for prior learning, classroom-based hands-on activities, outdoor education

activities, professional expertise gained through informal learning, and learning through social action and participation within a community of practitioners. In my own experience of performing cardio-pulmonary resuscitation, of putting my hands on the patient, by inserting a needle into the medicine port of the intravenous tubing, by seeing bystanders' faces of fear and curiosity, I was fully engaged in the moment and both activated prior learning and gained new knowledge through my experience. Adult education has long recognized experiential learning. John Dewey's 1938 book *Experience and Education* set the stage for critiquing standardized classroom education and developing a philosophy of experience. Dewey also pointed out that not all experiences educate. For example, a paramedic may encounter several separate calls for service where death of an infant occurs. This terrifying event may cause a severe and ongoing emotional reaction that impairs the paramedic's social and occupational functioning. In health care education we must design activities that are learning activities or as educators, we must provide educative affordances for learners to gain experience, competency or mastery. In Fenwick's (2003) review of Dewey's *Experience and Education*, she reports that there are two key dimensions to experience. First there must be *continuity* where the learner must connect the new experience to past learning. Engaging in competent paramedic practice, a paramedic can relate to the learning experiences from an internship in order to act and respond appropriately to emergency medical situations years later in practice. Second, there must be an *interaction* where the learner is actively engaged with the environment. For example, after responding to a motor vehicle collision involving a hybrid vehicle, the paramedic encounters a vehicle

with new battery systems, electrical wiring, and manufacturer warning stickers never seen before in standard vehicles. This motivates the paramedic to later search the Internet for information about rescuer safety and the high voltage battery systems of these new vehicles. Learners therefore, must be presented with learning experiences that connect to past events and where the experience itself allows for learning.

Experiential learning, for purposes of this paper, will be limited to the dimensions of learning as both a direct embodied experience and a collaborative experience. As a direct experience, the learner applies or gains knowledge through internships under various levels of supervision by experts. The learner plays the part of a paramedic, performs medical procedures, and makes limited decisions in patient care and outcome. As a collaborative experience, the learner participates in a community of practitioners. The culture of EMS and fire departments conform learners to an inherent form of behavior, language, and expectations. Learners become paramedics by acting like, speaking like, thinking like, and working with practicing paramedics. Knowledge is constructed through participation and interaction of the practitioner and the learner.

Experiential learning is prominent in adult education theory and practice. Health care education features learning through experience prominently – the majority of health education mandates some form of clinical experience as a requirement for graduation and entrance into the workforce. The primary approach to understanding experiential learning has centered on reflection on the embodied experience, termed constructivism. The constructivist paradigm emphasizes reflection on the experience (Merriam, Caffarella, & Baumgartner, 2007) and this conception of learning specifies that learners

construct knowledge by mentally reflecting on their particular experiences. The new knowledge that is formed and stored in memory can be transferred to new situations by learners who actively constructs their knowledge, and not through absorbing concepts passively.

Several adult educators have argued the primary role of experience in learning. Malcolm Knowles' (1970) theoretical perspective of andragogy and self-directed learning in particular focused attention on experience. Knowles held that learners enter an educational activity with an investment of activity and life experience and this investment defines them and directs them toward new learning based on their reflection of these activities. Other writers who prioritize experience and reflection include David Kolb (1984) who conceptualized that learning from experience requires: (1) involvement in a concrete experience; (2) observation and reflection on the concrete experience; (3) an ability to conceptualize and form the ideas and concepts based on the reflection; and, (4) the testing of new concepts through actual practice.

Other writers prioritize experience and reflection. Their work has transformed the learning experience from a passive process of information absorption to one of an active meaning-making process by the learner. As Fenwick states, "the individual constructs new knowledge through experimentation, guided by personal intension, selecting focuses for learning from possibilities presented in the environment, and reflectively analyzing these experiments" (Fenwick, 2003, p. 24). Constructivism is not without criticism. Kolb's model does not take the learner's context into consideration and other models of experiential learning within the constructivist framework are criticized for

their lack of attention to situational context and their narrow focus on the individual and the individual's mind (Fenwick, 2003).

Maria is nearing completion of her paramedic education. The last few months of her training includes supervised learning experiences in the emergency room to assist the hospital staff, in the operating room to perform patient airway management, and on the ambulance to work with a paramedic crew. Although she is nervous about working with hospital staff and seeing "real" patients, she is excited to finally be out of the classroom and be able to participate and see the patients and situations that have been discussed in lectures and from readings in the textbooks. She often commented to her classmates that the written exams and lectures were difficult for her and while she was making average grades, she knew that she would do better with hands-on experiences. This example illustrates a common preference of new paramedic students. Students develop an expectation that the classroom is an unnatural precursor to the "real" learning that occurs in the field. Maria may have read about the signs and symptoms of a patient suffering from an asthma attack. But the link between reading about asthma and kneeling next to a young man who is short of breath, coughing, wheezing, and whose face is filled with anxiety and fear while he struggles to breathe becomes a dramatic and powerful learning experience.

Most students have a sense that learning from experience is valuable, exciting, and is preferred over listening to lectures in a class and taking tests. By playing the part of the paramedic, the participant is more than transferring classroom learning to a real-

life scenario. Learners are active participants and employ the language, tools, culture, and expectations of the paramedic community.

Situated Cognition

A traditional understanding of learning and particularly didactic instruction presupposes a separation between what students should know and what they will do with that knowledge. Traditional didactic lecturing places primacy on passing knowledge from expert to student. Lecturing as a pedagogical method is often criticized for its one-way approach and the inherent passivity of students. Knowledge in this view is self-sufficient and independent from situations of use and application making the transfer of knowledge from teacher to learner independent of the context and application and perhaps even ancillary to learning (Brown, Collins, & Duguid, 1989). While teachers may view themselves as purveyors of knowledge and skills, experts and practitioners may use the formalized knowledge differently in real life. “Thus, students may pass exams but be unable to apply the same knowledge in everyday circumstances” (Choi & Hannafin, 1995, p. 53). Situated cognition as a theory holds that knowledge acquisition and creation cannot be disentangled from the context and culture of the real-world. All knowledge becomes a product of the activity and situations in which it is produced and will continually evolve as knowledge is reused and manipulated. Knowledge is under continual construction because meaning is inherited from the context of its use (Brown et al., 1989).

The theory of situated cognition developed from Gibson’s ecological psychology and theory of affordances and Vygotsky’s social learning theories. Both of these theories

hold that human actions and reactions are dependent on the context in which these occur, and they critique the cognitivist views of human behavior. Lave and Wenger (1991) further developed the theory asserting that the acquisition of knowledge occurs in the context of social relationships of a community of practice.

There are four claims to situated learning (Anderson, Reder, & Simon, 1996). First, action is grounded in the concrete situation in which it occurs. Lave (1988) typifies this point with her example of homemakers who were able to perform mathematical calculations at the supermarket but did much worse on comparable classroom examinations tasks. That learning is grounded in the actions of real-world events is a central claim to situated learning. Second, knowledge acquisition is bound to the context and unless there are similar situations it will not transfer. From an instructional design perspective, educators must have clear understandings of the context in order for learners who will function in that setting to be successful. The third claim is corollary to the first two which states that theoretical and abstract instruction is ineffective. Learning therefore is the result of the social interactions between learners and the community. The fourth premise of situated learning is instruction should occur in the dynamic, complex, and social situations of the real world. Learners should practice skills in their complex settings and participate with other learners. Through interaction with others, meaning is created and negotiated among participants of a community and learning is defined as the sharing of group narratives (Stein & Career, 1998).

The idea of social context as central to learning is an established subject of scholarly investigation. Having students demonstrate knowledge is both central to a

professions' expectations of competency and the bane of a professions' educators who are continually in search of ways to improve the transfer of learning from the classroom to clinical situations. Traditional models of instruction locate knowledge in the content that an instructor is teaching, and students are to absorb the flow of information in order to gain the knowledge. This is an example of the dualism created in the traditional symbol-processing view of cognition that is challenged by the situated cognition view. Bredo (1994) discusses these two views of understanding human thinking. The dominant, symbol-processing view of cognition presents thinking in terms of a computer performing operations on symbols. The second view of thinking is the situated cognition position where cognition is better perceived as involved in practical application of everyday situations. Newell and Simon's (1972) prominent model of cognition states that problem-solving consists of formal operations on symbols representing objects and relationships in the external world. Learners gather information to build mental models which are representations of reality and thinking, therefore, becomes manipulating this representation (Winograd & Flores, 1986). This model creates a set of operations designed to transform a current state to a goal state, and this sequence of actions is what is applied in real world settings. A fundamental view of symbol-processing is the acceptance of an existing, objective reality. A learner gathers and stores information about this reality and this mental model will be either rightly or wrongly representative. Learners then use sentences that mirror reality and are measured against what is possessed by the teacher. Bredo (1994) challenges this model of learning:

The educational equivalent of this belief is the view that knowledge representing how the world “really” is must be transmitted to students. When they have the same statements in their heads as the teacher, it is presumed that they “know” something (Language and Reality section, para. 3).

Reality is seen as language-independent, creating a language and reality duality. This is one of three dualities of subject/object that symbol-processing creates as described by Bredo’s review of paradigmatic research from the perspectives of symbol-processing and from situated cognition. A second dualism involves a separation of mind and body. Students passively sitting in a classroom absorbing knowledge and being tested represents this second type of dualism. A third subject/object divide involves the separation of individual and group in symbol-processing research. From an educational perspective, observing students perform a standardized task separates an individual from social influences. “However, knowing the task assumes that there is one correct interpretation of what is going on” (Bredo, 1994, Individual and society section, para. 2). If a learner has a different interpretation from the ‘right’ one, judgments of performance can be misleading.

Bredo continues his outline of approaches to understanding human thinking and learning with an alternative description using situated cognition, whose proponents suggest that cognition be conceived in the practical doings of people in their everyday lives (Lave, 1988). The dualism is less apparent. Language is seen as a means for social adaptation where learning is a social activity and not a means of transmitting knowledge from one person to another. Regarding the mind and body, “there is no dualistic

separation of mind and body because the physical interaction involved in inquiry is part of the process of acting mindfully (Bredo, 1994, *Mind and Body*, para. 3). Whereas in the symbolic-processing model the individual and society held the belief that students should work alone because learning is a private matter, in the situated cognition view the individual and social change are inseparable because learning is shared and distributed among all the participants. “Learning is a process that takes place in a participation framework, not in an individual mind” (Lave & Wenger, 1991, p. 15). Bredo’s opening statement in his review makes an important summarization, “the symbol-processing approach begins with theory and works towards practice, while the situated approach begins with practice and works towards theory” (Bredo, 1994, para. 2).

While Bredo’s description lays a foundation for understanding the philosophy of situated cognition, much of the educational theory is credited to works of social anthropologist Jean Lave. Situated cognition proposes that learning is mainly a social phenomenon and this notion of the primacy of context has increasingly been mentioned in the discussion of learning for adults (Fenwick, 2000; Hansman, 2001; Wilson, 1993). Lave and Wenger (1991b) describe a situated learning environment as one where the skills and knowledge are learned in contexts that reflect how that knowledge is gained and applied in everyday situations. Learning is the process of meaning-making from the interactions between learner and the activities of doing. Subject matter is embedded in the experiences of learners and these experiences, which create challenges and opportunities, allow knowledge to be created and acquired and assists the transfer of knowledge from the classroom to practice.

Paramedics view what happens through the values and norms of a prehospital emergency care culture. Paramedics learn from their coworkers, their employers, their professional expectations, and other medical professionals. These co-producers of knowledge demonstrate to paramedics what actions are acceptable, what language is appropriate, and scaffold new learning and experiences. Through the community, paramedics learn what is important, normal, and acceptable. But what makes the context so central to experiential learning? What is the context that learning *in situ* prioritizes? The primacy of context develops due to the authenticity of learning tasks and the situational factors that promote knowledge transfer.

Context and Authenticity in Learning

Abstract concepts and textbook examples are insufficient for learners to develop the skills, attitudes, and knowledge of a domain of practice or profession. Learners must engage in activities that are socially constructed and negotiated between members. Authentic tasks are coherent, meaningful, and purposeful activities that are the practices of a culture (Brown et al., 1989). The classroom mutes the authentic activities of practitioners and would in many instances be unrecognizable by practitioners. The classroom activity becomes a product of its own culture while attributing it to another. “This hybrid activity, furthermore, limits students’ access to the important structuring and supporting cues that arise from the context” (Brown et al., 1989, p. 35). In health care education, without activities that reflect the ill-defined and fluid nature of a medical situation, students practice contextualized scenarios and answer paper tests and risk becoming overconfident or overwhelmed when placed in real-world situations as new

graduates. Authentic tasks enable learners to develop situation awareness, or situational intent; that context provides cues for problem-solving strategies and enables learners to exploit situational resources (Choi & Hannafin, 1995).

Whitehead (1932) described knowledge as inert when it fails to be used in contexts in which it is needed. Studies indicate that what is taught in school is stripped of context and divorced from what is done in practice. Information is often taught as abstract facts and separated between knowing and doing (Bransford, Sherwood, Hasselbring, Kinzer, & Williams, 1990; Resnick, 1987). Retrievable knowledge is needed in order to be successful in real-world environments and when learning and context separate, knowledge becomes an end product of learning rather than a tool used to solve problems (Herrington & Oliver, 2000). Lave's (1988) ethnographic study of arithmetic problem-solving illustrates this separation with how "just plain folks" solve real-world math problems. She describes how an authentic activity enables the situation to find a solution. A participant in a Weight Watchers class is asked to reduce the size of a recipe that included cottage cheese. This participant, who had taken a college calculus course, needed to take three-quarters of two-thirds of a cup of cottage cheese. Rather than relying on mathematical formulae or algorithms learned as a student, he placed two-thirds of a cup of cottage cheese on a cutting board, formed it into a circle, divided it into four quadrants and removed one quadrant. In this example, the context framed the thinking and the problem-solving. Brown (1989) contrasts behaviors of "just plain folks," practitioners, and students. In terms of reasoning and problem-solving, the "just plain folks" and the practitioners are similar. Both use casual models to reason, act on

the situations at hand, and negotiate meaning to develop a socially constructed understanding. Students in a traditional classroom, on the other hand, reason with laws, act on symbols, and produce or rely upon fixed meanings and immutable concepts. These are inauthentic learning activities because they diminish individual discovery and unique problem-solving strategies, and because there is absolutism implied in having a teacher or textbook designate a final right answer. Providing authentic activities for learners places the learner in the social milieu of knowledge and application, context and practice. In terms of instructional strategies, it means that teachers are now called upon to provide opportunities for engagement and discovery rather than to be distributors of knowledge.

Transfer of Knowledge to Other Contexts

Authentic activities influence learning by promoting knowledge acquisition that resembles knowledge use. A second, yet closely related, way context influences learning is due to the situational factors that promote knowledge transfer. The need for teachers to make knowledge relevant and useful is not new but it is inadequate to simply provide examples of real-world problems or answering the timeless question from learners, “Why do I need to know this?” There is a continuum of opinion on the question of how knowledge developed through experience transfers to other situations. Paramedic practice is a dynamic and fast-paced interaction between patient, environment, and co-workers. While not every patient who seeks emergency care for abdominal pain, for example, is the same, the paramedic banks the knowledge and experience from one encounter to be withdrawn on another patient with abdominal pain. Fenwick (2003) describes this

continuum with constructivists on one side that place transfer of learning as spontaneous and unassisted and the situative view on the other side argues that learning is different because each context requires different levels of participation. According to constructivists, transfer of learning can be increased when learners are given multiple examples, situations, practice, and assistance to adapt knowledge skills in new contexts. Situative theorists' notion of knowledge transfer prioritizes the assistance provided by supervisors, co-workers and peers, as well as the authentic opportunities to use new skills in new contexts. Both ends of this continuum regarding knowledge transfer place the individual as the site of knowledge (Fenwick, 2003). Some researchers have attributed the problems with knowledge transfer to formal learning methods (Choi & Hannafin, 1995). While knowledge is a direct determinant of performance (Hunter, 1986; Kuncel, Hezlett, & Ones, 2004), research now suggests that general skills often do not promote the transfer of knowledge (Brown & Duguid, 1993; Norman, 1992; Perkins & Salomon, 1989). It is the context in which skills are learned that promotes their effectiveness.

When learning occurs in simplified, classroom-bound, decontextualized environments, more complete knowledge application is constrained. Authentic tasks that promote ill-defined situations, replicate real-world dynamism, and foster the use of knowledge as a tool promote the transfer of knowledge and skills to the milieu of the practitioner.

Pedagogy of Practice: Creating Situated Learning Environments

In the previous section, I outlined how context directs cognition and how instruction designed with authentic tasks promotes transfer of learning, but context alone is not a guarantee of learning. In this section I address the way educators can create situative learning environments through cognitive apprenticeships and communities of practice.

Ever since ancient times, apprenticeships were the primary method used to transfer knowledge and skill. Learning from a master the art of woodworking, blacksmithing, pottery, or ironwork was the natural way to learn. This stands in contradiction to contemporary educational practices that assume knowledge is individual and unaffected by the activities of acquisition and use. Traditional medical training relies on the apprenticeship model of learning. Students observe and assist as patients present which means students must spend numerous hours in training in order to encounter as many medical cases as possible. Medical education's reliance on traditional apprenticeships to learn or maintain proficiency is being recognized as deficient (Dornan, 2005; Issenberg et al., 1999; Wang et al., 2004) and in today's professional and social climate it is no longer acceptable for novices to learn invasive skills on real patients, thus risking injury or harm (Kneebone, Scott, Darzi, & Horrocks, 2004). The practice in paramedic education also follows a traditional apprenticeship model. Paramedic training typically relies on a minimum number of hours in various clinical sites in order to observe and assist with different kinds of medical cases. Despite the move from an hours-based training to competency-based, learning during clinical

training is largely by observation, trial and error, and practice. Different clinical experiences yield varying degrees of experience and aptitude between students. Cognitive apprenticeships take traditional apprenticeships to a new level by offering a way in which the concept of authentic experience within a community is practiced by educators. Cognitive apprenticeships are a more effective method of learning because the learner is engaged with others to learn, perceive, interpret, refine, apply, and reflect upon the experiences of interaction and application. If educators are to guide and direct situative learning environment, the differences between traditional apprenticeships and cognitive apprenticeships must be understood.

Traditional craft apprenticeships are designed to allow an apprentice to take on the role of a practitioner through experiential learning. In this model, an expert demonstrates and teaches the apprentice how to do a task. The steps of a skill are observable and tangible with outcomes readily identifiable. There are four key aspects of traditional apprenticeship: modeling, scaffolding, fading, and coaching (Collins, Brown, & Holum, 1991). In modeling, the master is the source of a skills design and criteria and apprentices primarily learn by watching. Scaffolding allows an apprentice support as the task is carried out and as the apprentice engages the task. In the fading process, the support given during the scaffolding phase is decreased as the proficiency of the apprentice increases. Coaching is inherent in all four aspects of the apprenticeship. The master assists the apprentice through verbal hints and physical cues, encouragement and correction, allows for continued practice and evaluation, and supports the apprentice through the learning process. The dynamic interplay between these four phases allows an

apprentice to see the skill, try the skill, be given feedback and correction, and modify the skill based on benchmarks from the master and from other students. A key feature of the apprenticeship is the intertwining of the environment with the performing of the skill. Textbook examples and classroom exams fail to achieve the authenticity inherent when content and context interplay.

A cognitive apprenticeship is formed when a designed simulated environment is combined with direct assistance (Brandt, Farmer, & Buckmaster, 1993). This involves five phases. The first phase, modeling, is where a demonstration of the activity is presented along with a verbal description. In phase 2, approximating, the learner performs the activity with coaching and scaffolding provided as needed. Fading is the third phase where the coaching and scaffolding are gradually removed and the learner works in increasingly complex or ill-defined situations. In phase 4, self-directed learning, the assistance is only provided when requested as learners operate more independently. Phase five, generalizing, the goal is transferring the skill to new situations through discussion and demonstration.

There are three important differences between traditional apprenticeships and cognitive apprenticeships (Collins et al., 1991). First, in a traditional apprenticeship, the task being performed is observable, but in a cognitive apprenticeship the thinking must be deliberately brought to the surface by the teacher. Tacit processes of both teacher and learner are exposed so the learner can observe and practice the skill. By having thought processes exposed, not only is the skill improvable but the apprenticeship techniques move beyond the mere physical skills to the metacognitive processes of skill

development. The social construction of knowledge becomes evident in the explicit exchange and modification of ideas and belief systems, so learning environments must encourage verbalization and conversation among students and with the instructor.

The second difference is that in a traditional apprenticeship, learning is completely situated where learners are independent reflective constructors of knowledge (Fenwick, 2003). An apprentice is naturally motivated because he or she sees the experts' finished, tangible product making the value of learning clear. But much of what is taught in a traditional classroom is completely separated from what the learner will do in their paramedic practice. "In cognitive apprenticeship, then, the challenge is to situate the abstract tasks of the school curriculum in contexts that make sense to students" (Collins et al., 1991, p. 3).

Third, in traditional apprenticeship, learners will not encounter situations where the transfer of a skill is required. The skill that is learned belongs intrinsically in the task itself. But when students are learning in the classroom to be a paramedic, what is learned must be transferred. Learning in cognitive apprenticeship, teachers must present a range of tasks and encourage learners to reflect on the common elements of a task in increasingly diverse situations. "The goal is to help students generalize the skill, to learn when the skill is or is not applicable, and to transfer the skill independently when faced with novel situations" (Collins et al., 1991, p. 3).

Despite the legal and ethical arguments for students learning and practicing on patients, cognitive apprenticeships have received much attention in the literature on educating medical personnel. As Collins, Brown, and Holum (1991) describe, classroom

activities are often hidden. Problem solving, reading comprehension, and writing is not as obvious as those activities performed in an apprenticeship setting. The very nature of an apprenticeship allows a student or novice to observe the actions of a master or practitioner. “Cognitive apprenticeship is a model of instruction that works to make thinking visible” (p. 6).

In health care education, cognitive apprenticeships have the potential to enable learners to see the culture of caring for patients and dynamic nuances of medical skills and affective behaviors. My own learning was developed in a required internship, which was essentially a traditional apprenticeship, and this experience allowed me to observe, test, and try my skills in a role just below that of an independent practitioner. Scaffolding and coaching were provided in the form of subtle hints, stern corrections, public questioning, and honest assessments while sitting in the back of an ambulance after a medical call. Many times it was not only a preceptor, incidental co-worker, or other classmate involved, but also the patient who contributed to my developing knowledge base. The patient became a living classroom and virtual textbook that provided the beginning experiences to form me as a paramedic. Unfortunately, many times in the apprenticeship observation was the primary goal. Learning and practicing were incidental or haphazard. For example, learning to take a blood pressure reading is an explicit skill. However, novices must apply and develop the cognitive and metacognitive strategies that guide the decision-making process (Taylor & Care, 1999). Missing in many of my clinical training experiences were the components unique to a cognitive apprenticeship. I learned the explicit knowledge and skills required to perform a blood

pressure reading, but there was no intentional instruction or reflection on the internal process of cognition or application of the skill with a teacher or preceptor. What was missing were the situational factors that influenced my decisions to check a blood pressure. Different medical conditions impact one's blood pressure. Perhaps the preceptor could ask me why I should use the right or left arm in the blood pressure measurement. A comparison between a blood pressure measured by the sphygmomanometer and an automatic blood pressure machine could be performed. What are the patient priorities that would require me to take more or less frequent blood pressure readings on the same patient? What are the indications for using smaller or larger sized blood pressure cuffs? Engaging questions like these would have helped create a cognitive apprenticeship and significantly increased my learning.

An important historical consideration must be considered to understand why paramedic clinical training is deficient. The training of doctors and nurses, for example, rely on the apprenticeship model because medical and nursing students historically are trained in the same hospitals in which they will perform independently. Until the 1960s, hospital schools of nursing were the dominant form of professional education of nurses (Taylor & Care, 1999). These hospital-based nursing programs allowed students to begin in the periphery of the profession, work with practicing nurses in the hospital, then progress towards independence and employment. Taylor and Care highlight an important change in nursing education that changed the nature of the apprenticeship model. As the domain of nursing knowledge increased, the primary responsibility for nursing education shifted from hospitals to college and university programs. This resulted in increased

emphasis in the theoretical components to nursing practice. The training hospital originally used nursing students as part of baseline staffing, but the new nursing programs required fewer hours in clinical practice due to the increase in classroom instruction. Second, as faculty of higher education institutions, clinical instructors were no longer nurses located in hospitals. This changed the apprenticeship model by reducing clinical experiences and opportunities to interact with practitioners. Paramedic clinical education mirrors nursing education in this regard. While I was afforded hours of clinical exposure, a cognitive apprenticeship approach was missing. As the theoretical foundation of paramedicine grows, it will be increasingly imperative to review and modify the traditional apprenticeship approach to education. The cognitive apprenticeship emphasizes the context-dependent and situated nature of culturally embedded and socially generated content while externalizing tacit knowledge of expert practice.

Communities of Practice

The traditional model of clinical education has always used the apprenticeship approach where the student observes the master to learn the craft. The more contemporary approach of cognitive apprenticeships and communities of practice are challenging this traditional approach by revealing a deeper set of social relationships through which learning takes place between novices and advanced practitioners. Wenger (n.d.) defines communities of practice as “groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly” (n.d., What are communities of practice? para. 1). As discussed previously, Lave and

Wenger (1991) emphasize the primacy of social context in the acquisition of knowledge (e.g., situated learning) and the community of practice is the context within which it occurs. Wenger (n.d.) outlines three critical characteristics of communities of practice. First is the domain. A community is formed by its common area of interest which goes beyond mere membership in a club or group of comparable individuals. Membership in a domain is distinguished by the knowledge and competence that is shared and by the commitment members have to that domain. In addition, further distinction from outsiders is created by the level of competence that members share. Second is the community. By having members interact and learn together, they build relationships with one another. This community goes beyond workers with the same titles or cyber-relationships in special-interest websites. Members of a community of practice must interact and learn together, sharing knowledge and experiences. The third characteristic of a community of practice is the practice itself. The sharing of resources, experiences, knowledge, and purposeful engagement creates a repertoire of resources. These resources are called upon to address problems found within the community and domain. Paramedics constitute a community of practice; they can meet at a hospital between calls and discuss specific patient cases and share problems and solutions. These stories can transmit knowledge that other paramedics can use and develop on their own. Domain, community, and practice are the three defining elements for a community of practice and these three elements, along with the ideas of cognitive apprenticeships, can help educators create learning opportunities where these communities flourish and where knowledge is created and shared.

Developing Expertise

Wenger (2002) suggests that learning and practice cannot be separated when professionals work in communities of practice. Paramedic students participate in mandated clinical settings with increasing levels of independence (though as students they are never fully independent). During these cognitive apprenticeships, students work within a community of practice. Paramedics act as preceptors and students work with other students and others within the health care community, such as nurses, doctors, laboratory assistants, x-ray technicians, respiratory therapists, physician assistants, police, firefighters, and other aides and technicians. Students learn in a continuum from observation to near-independent practice of various paramedic skills and knowledge. Because these experiences are happening outside of the classroom and within communities of practice, the students learn new competencies and procedures. Students participate in the exchange of tacit and explicit knowledge of the profession and progress through stages of increasing competency. Dreyfus and Dreyfus (1986) created a model of the development of knowledge and skill based on their study of chess players, adults learning a second language, adults learning to drive an automobile, and US Air Force pilots learning to fly. The Dreyfus model is a model of skill acquisition that describes how people progress through five levels of developing proficiency: novice, advanced beginner, competent, proficient, and expert. This model is best illustrated by the work of Benner (2004), who used the Dreyfus model of skill acquisition to define stages in the development of clinical competence in nurses. The novice stage begins with a student who has no experience or background in the clinical situation. The novice is given a set

of rules and learns to recognize features of a task to be learning and follows the procedures by drill and practice. For example, a paramedic student is given a set of directives which require blood pressure, respirations, and pulse rate to be taken every five minutes. Practicing paramedics with experience will recognize many clinical situations in which these requirements would be too stringent and would even be counterproductive. A novice does not have the background to understand why or when these rules can be modified. In stage 2, advanced beginners are those who can demonstrate marginally acceptable performance but they have not dealt with enough real situations to perform at a higher level. With more experience the advanced beginner progresses to stage 3, competence. In this stage a practitioner is initially overwhelmed with the number of potentially relevant elements and procedures. This is typified by the nurse who has been on the job in the same situation for two or three years. The key feature of this stage is that the learner makes an emotional investment in the choice of action. Learners begin to devise a plan which determines which elements of the situation must be treated as important, although they lack the speed and flexibility of the proficient nurse. At stage 4, proficiency, intuitive reactions replace reasoned responses. Involvement is the key to progressing into this stage. The positive and negative emotional experiences strengthen successful responses and reduce unsuccessful ones. Rules and principles become replaced with situational discriminations and associated responses, and there is a holistic understanding of clinical situations. At the last level, stage 5, expertise, the learner not only sees what needs to be achieved but also sees immediately how to achieve the goal. The expert operates from a deep understanding of

the whole situation based on an enormous background of experiences. It is the ability to make subtle discrimination of contextual clues and possible actions that distinguishes the expert from the proficient performer.

The Dreyfus Model illustrates how experiential learning during real-world practice enables students to master the skills of a profession. This model also requires an engaged learner committed to improving practice by reflecting on past experiences – each past event creates a foundation upon which expertise can be built. “In the Dreyfus model, the practitioner is assumed to dwell with increasing skill and finesse in a meaningful, intelligible, but changing, world” (Benner, 2004, p. 198). Those who work as the master or practitioner in apprenticeship settings should understand where their intern or apprentice is in the Dreyfus continuum in order to foster progress in their students.

Conclusion

I have been privileged to work in health care. Being with people who are sick or injured affords me the opportunity to exercise expertise, confidence, and compassion for those who are most vulnerable. In order to best prepare the next generation of paramedic and emergency responders, health care educators must help students acquire clinical expertise through externalizing metacognitive strategies. The traditional apprenticeship is not adequate to convey the knowledge and skills needed to perform as a paramedic. Effective teaching strategies must incorporate the social and physical environment in which our patients reside, exposing tacit procedural and cultural knowledge, and engaging students in observation, participation, and conversation with other paramedics.

In addition, situating learning within a community of practice is crucial for learning to be most effective and to best prepare students for the ill-structuredness of emergency care. Every EMS call is unique. No two patients are ever the same and no two scenes are similar. I learn from every encounter with patient, co-worker, or bystander. The outcome of my first cardiac arrest experience further deepened my learning and knowledge. The patient died. It is not unethical or disrespectful to describe this event as a learning experience. It would be unethical and disrespectful to not reflect upon, learn from, and take away a new set of knowledge and skills to be used in other situations. Now as an educator, it is my responsibility to prepare paramedics to function and flourish in new and unique situations. Theories of situated cognition provide a view of learning that breaks from traditional models. When context, content, and community merge, knowledge is generated in new and meaningful ways. By participating in communities of practice, knowledge is transferred, created, and altered along with the learner through active engagement with all the ill-structured, dynamic, and unpredicted opportunities the 'real world' offers. As educators, we are now called to design meaningful learning activities that value the contributions of learners and the role of context, as knowledge becomes more explicit within and between learners.

CHAPTER III

SKILL ACQUISITION IN SITUATED LEARNING ENVIRONMENTS: DO
STUDENTS WHO DIFFER IN TERMS OF THE NUMBER OF TRACHEAL
INTUBATIONS DIFFER IN TERMS OF PARAMEDIC CERTIFYING
EXAMINATION SCORES?

Introduction

The roots of emergency medical services (EMS) are deep in history. They range from Napoleonic battlefield tactics caring for injured soldiers, to the National Academy of Sciences research into accidental death and injury, to the present-day expectations of public access to 911 and professional prehospital emergency care and transportation. While precise definitions of EMS are varied, its foundations are found in emergency and trauma care, cardiology, and military medicine. Its present and future are found in disciplines such as healthcare, injury prevention, public health, allied health, and homeland security. Modern EMS in the United States likely began with the publication of the National Academy of Sciences' paper titled *Accidental Death and Disability: The Neglected Disease of Modern Society*. This historic report found that in the previous year, 52 million accidental injuries killed 107,000 Americans, temporarily disabled more than 10 million, and permanently impaired 400,000 more at a cost of approximately \$18 billion. Congress responded to the report by enacting the National Highway Safety Act of 1966, which mandated the Department of Transportation (DOT) to establish minimum standards for provision of care for accident victims. DOT and the National Highway Traffic Safety Administration (NHTSA), a DOT agency, took the federal

leadership role in the creation and funding of EMS systems in the ensuing years, providing more than \$48 million for EMS between 1966 and 1973, creating national standard curricula for Emergency Medical Technician-Basics, Intermediates and Paramedics, and defining the necessary components of an EMS system ("EMS: Where We've Been and Where We're Going ", n.d.)

While initially EMS in the United States was designed to respond to accidental death and disability and cardiac emergencies outside the hospital, today EMS has become the public safety net and the entry point into the health care system for many people who are noninsured or underinsured. EMS plays an increasingly significant role in society with increased focus on the effects of natural disasters, national and international conflicts, mass casualties, weapons of mass destruction and mass effect, as well as public health issues concerning patients access to care and cost reimbursements. EMS plays both a public safety and public health role.

For over 20 years, tracheal intubation (TI) has been the cornerstone of emergency care and today it is an essential skill for EMS personnel and is the standard of care for critically ill patients cared for by paramedics in the out-of-hospital setting (*Emergency medical technician-Paramedic: national standard curriculum (EMT-P)*, 1998). It is a core occupational skill required of all paramedics in training and is one of 12 skills verified on the national certifying examination for paramedics. Clinically, tracheal intubation has been reported to improve survival in acutely ill patients (Pepe, Copass, & Joyce, 1985), and failure to perform successful tracheal intubation can sometimes result in patient death (Mulcaster et al., 2003). In addition, tracheal intubation "is a complex

skill in which proficiency is likely linked to expertise” (Cady & Pirrallo, 2005, pp. 868-869). These three components related to tracheal intubation: a gold standard in airway management, a determinate in patient outcome, and a complex skill, represents a *triad of criticality* for health care professionals that utilize this procedure.

The public and employers demand that graduates from health care education programs be competent in a wide range of skills and knowledge. Education programs in EMS, despite a current lack of national certification standards, are guided by national educational objectives with local and regional modifications. Emergency health care delivery occurs in an ever-changing and complex environment. The skills that are required of graduates include problem solving, high-level cognition, and dealing with ambiguity and conflicting priorities. Being competent care givers also requires graduates who are technically competent and culturally sensitive. The history of the EMS education system developed in spite of a national consensus or master plan. Quality EMS education attributes such as national standard curricula, accreditation standards, and a national registration system have emerged during the last thirty years. Over the past thirty years, national curricula became longer in required hours and more detailed in required knowledge and skill.

Today’s EMS workers are expected to possess task-oriented skills as well as mastery of basic academic skills needed for problem-solving capabilities and preparation for life-long learning. Educators must recognize, assess, and foster competence that goes beyond being just technically adept. Stark (1986) proposed that professional competence includes six subcategories. First, conceptual competence is the understanding of the

theoretical foundations of the professions. Second, technical competence is the ability to perform tasks required of the profession. Third, interpersonal competence involves the ability to use written and oral communications effectively. Fourth, contextual competence is the understanding of the societal context in which the profession is practiced. Fifth is integrative competence which is the ability to combine theory and technical skills in actual practice. And sixth is adaptive competence, the ability to anticipate and accommodate changes important to the profession.

Educators find it difficult to identify specific objective material in standardized curriculum for contextual, integrative, and adaptive competence. But these are as critical as the other subcategories of competence. Contextual competence, for example, becomes the focus when educators must develop learning opportunities that closely resemble actual practice environments. Despite the growing emergence of human patient simulation training with advanced computerized models and mannequins, students who become practitioners enter a community of paramedic practice. The practice of paramedic involves more than conceptual and technical competence. It involves attitudes, language, expectations, and actions that are accepted or rejected by the community. No simulation can reproduce completely what it means to act like a paramedic, either in terms of technical skill or model of behavior. Educators therefore, are called to create learning opportunities that are situated in the context that most closely resembles the context of actual practice, where the knowledge learned is the knowledge to be used.

Statement of the Problem

Healthcare professionals routinely perform medical procedures. In the case of tracheal intubation, a life-saving skill taught to many healthcare professionals, specific guidelines for training have not been widely addressed. Educational programs may use mannequins that can range from simple anatomically-correct head and upper torso recreations to technologically sophisticated human simulations with modifiable anatomical structures and actual sound and voice recreations. In addition, there is no requirement that EMS education programs use actual patients to gain competence in tracheal intubation. Currently, the NREMT Paramedic Certifying Examination includes a practical component where a candidate performs the skill of TI on a simple airway mannequin demonstrating the procedure sequentially for the examiner. To date, no research study has been reported that identifies the relationship between the quality (live patient vs. mannequin) and quantity of intubations performed during training and performance on the NREMT Paramedic written certifying examination.

Purpose of the Study

The purpose of this investigation will be to determine if a link exists between learners' participation and advancement within a sociocultural community of practice as specifically evidenced by higher rates of tracheal intubations on live patients and scores on the NREMT certifying examination. While the present investigation is not designed to determine the relationship between the educational experience and performance in real-life (after graduation and certification), it is the researcher's intention to determine if individuals who differ in the number and type of intubations acquired in training exhibit

differences in scores on the NREMT examination in order to develop training benchmarks. For example, the specific number of TIs required during training to improve NREMT pass rates.

Assumptions

Two critical assumptions guide this research. First, learning and thinking in the everyday world are primarily social activities. For example, the success of performing prehospital tracheal intubations is mediated by a myriad of environment factors, variations in patient anatomy, and underlying pathology. The proficiency of the student performing the intubation is mediated by learning experiences and learning experiences are influenced by the context in which the learning occurs. Context structures knowing and learning, and all knowledge becomes a product of the activity and situations in which it is produced and will continually evolve as knowledge is reused and manipulated. This knowledge is under continual construction because meaning is inherited from the context of its use (Collins, Brown, & Newman, 1989). When thinking and learning are considered social activities, the learning of the skill of intubation becomes structured by interactions between learner, patient, co-workers, environment, and the tools of the situation which include language, narratives, past experiences, and the medical devices. A cognitive orientation to learning locates learning in the mind of the individual and explains it in terms of mental processes in which knowledge is stored and retrieved for use in a variety of settings (Rubenson, 1989). The alternative situated cognition view states that the individual and social change are inseparable because learning is shared and distributed among all the participants. “Learning is a process that

takes place in a participation framework, not in an individual mind” (Lave & Wenger, 1991, p. 15). When learning occurs in simplified, classroom-bound, decontextualized environments, more complete knowledge application is constrained. Authentic learning tasks that promote ill-defined situations, replicate real-world dynamism, and foster the use of knowledge as a tool promote the transfer of knowledge and skills to the milieu of the practitioner.

This leads to the second assumption made for this research. The more intubations paramedic students perform on live patients, the more they are exposed to the authenticity of the practitioner’s reality and the more situated their learning becomes. Learners must engage in activities that are socially constructed and negotiated between participants because this dynamic simulates real-world problems, solutions, and actions. These *authentic tasks* are coherent, meaningful, and purposeful activities that are the practices of a culture (Brown, Collins, & Duguid, 1989). The classroom mutes the authentic activities of practitioners and would in many instances be unrecognizable by practitioners. The classroom activity becomes a product of its own culture while attributing it to another. “This hybrid activity, furthermore, limits students’ access to the important structuring and supporting cues that arise from the context” (Brown et al., 1989, p. 35). For purposes of this study, learning activities are ‘more situated’ and authentic with higher numbers of intubations by paramedic students because learners are being exposed to higher numbers of authentic, real-world activities, and therefore are participants within a community of practice.

Significance

Tracheal intubation has been performed in the out-of-hospital emergency setting for over 20 years (Jacobs, Berrizbeitia, Bennett, & Madigan, 1983). Despite its history, recent researchers have questioned its use in EMS due to poor patient outcomes when performed incorrectly and lack of improved outcomes despite correct placement (Gausche et al., 2000; Katz & Falk, 2001). Detrimental consequences of TI could be the result of inadequate training and education of paramedics, inadequate amount of TIs during training, or improper assumptions of competence by successful passing of the NREMT examination. The findings of this study may help create benchmarks for EMS training programs by demonstrating if a significant connection between number of intubations and NREMT examination scores exists. Second, while the purpose of this study is to study differences between simulation and real-patient training, a review of situated learning and its implications for out-of-hospital education and training will spark debate as to the appropriateness of learning in-context (real-world experiences) versus simulation training (i.e., mannequins) for TI. The findings of this study can be used by paramedic program directors in developing training benchmarks in TI and assist in identifying links between the quantity of psychomotor experiences and didactic performance on written examinations. This will strengthen validity claims for examinations that are used to declare performance and knowledge competency.

Review of the Literature

Three areas of literature inform this study. Discussed first are training issues in the medical literature about tracheal intubation, This skill is taught in several disciplines

in medicine and allied health. Regardless of the discipline, tracheal intubation is a complex psychomotor skill that requires appropriate instruction; therefore, issues of training and knowledge transfer are investigated as well as an introduction regarding the process of paramedic certification. The second area of literature addresses how this training develops and sustains professional competence and what the process of skill acquisition entails. Particular attention will be placed on how competence is defined in the medical, nursing, and paramedic literature. Paramedic practice requires the application of complex combinations of knowledge, skills, and affective characteristics. In the skill of tracheal intubation, paramedic training programs currently do not have benchmarks. In other words, there is no nationally agreed upon requirement for the number of intubations a student should acquire or what is needed to reach competency on this skill. Many methods of didactic education assume a separation between knowing and doing which treats knowledge as theoretically independent of the situation where it would be used. The third area of literature takes up issues of paramedic training and skills acquisition in the theory of situated cognition and how this theory conceives of learning. How situated learning is defined, utilized, and can be further developed in paramedic education and in particular in the instruction of tracheal intubation are explored.

Training and Testing of Tracheal Intubation

Paramedics are licensed or certified at the state and/or national level. The National Registry of Emergency Medical Technician's (NREMT) is the private agency that currently develops and administers the paramedic level certification at the national

level. To date, there are 43 states that recognize NREMT certification. Officials in the remaining states develop and administer a state-level examination. The NREMT written examination is a criterion-based examination containing 180 multiple choice questions covering six topics. A passing score requires that the candidate obtain a minimum passing score in each topical area plus an overall passing score. The Airway and Breathing topic contains between 27 and 33 items. The purpose of the NREMT test is to identify entry-level competent EMTs that are able to safely and effectively practice. Paramedic students may be required to intubate patients during their clinical phase of instruction. Endotracheal intubation is a procedure by which a tube is inserted through the mouth into the trachea (the large airway from the mouth to the lungs). The endotracheal tube serves as an open passage through the upper airway. The purpose of endotracheal intubation is to permit air to pass freely to and from the lungs in order to ventilate the lungs. Endotracheal tubes can be connected to ventilator machines or mechanical airway equipment to provide artificial respiration. The National Standard Curriculum (NSC) recommends that students complete five intubations on live patients; however, this number varies widely by community college or university, and by region of the country. The reason for this variation in live intubations is due to access to surgical sites (where the majority of intubations are performed) and competition for access by other students (medical and respiratory care students primarily). Most paramedic schools therefore will utilize training mannequins and simulators to replace live patients; if live intubations are required, the numbers are often very low (e.g., one). Many models exist for training paramedics in the skill of tracheal intubation. The cornerstone of any skill

acquisition is to begin with the basic sciences, practice the skill, and then proceed to actual patients. “For airway skills this means a review of the anatomy of the airway and physics behind the equipment followed by the teaching of the technical skill” (Gaiser, 2000, p. 516). This can be done through the traditional forms of instruction such as a lecture, or it can be done through computer-based instruction or web-based learning. The current standard for teaching paramedics after this initial phase is to practice on airway mannequins and then progress to operating room settings under the direct supervision of a physician. Howells, Emery, and Twentyman (1973) were early reviewers of the use of a training mannequin, and although they found issues with adequate anatomical representation, they did find this teaching strategy useful. It has remained the most used and accessible of the airway training options (Owen & Plummer, 2002) and has been determined to be an effective training method (Stratton et al., 1991). Technological advances have provided more advanced human patient simulators. These devices are controlled by computer software and allow the mannequin to move, speak, and simulate medical conditions that are more representative of the variety of real patients and medical scenarios. Hall, et al. (2005) found that paramedic students who were tested in the operating room setting, after training to intubate on a human patient simulator, are as effective as students trained on human subjects. Abrahamson, Denson, and Wolf (2004) found that these simulators were beneficial because they provided immediate feedback to the student, offered progressively increased levels of difficulty, and allowed unlimited repetition of the procedure. Some training programs utilize video of the actual procedure from the perspective of the one performing the intubation. An instructional videotape

made with a direct laryngoscopy video system significantly improved the initial success rates of novice intubators in an operating room setting (Levitan, Goldman, Bryan, Shofer, & Herlich, 2001). Virtual reality simulators have been shown to be effective in tracheal intubation instruction (Rowe & Cohen, 2002), and even a unique animal model using deer heads was shown to be satisfactory (Cummings, Valentini, & Getz, 2005).

Educational programs utilize simulation for valid reasons but there is a “danger that simulation may become an end in itself, disconnected from the professional practice for which it purports to be a preparation” (Kneebone, Scott, Darzi, & Horrocks, 2004, p. 1099). Regardless of the methodology employed, obtaining competence in tracheal intubation is the goal of training programs. The acquisition of procedural competence is needed by paramedic students learning tracheal intubation, and to achieve that, it is necessary to have access to patients. As previously discussed, access to clinical experiences for paramedic students is difficult. Recent American Heart Association guidelines have suggested that advanced life support providers should have regular field experience, defined as 6–12 intubations per year, as a prerequisite to patient tracheal intubation skills ("Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care," 2000). Students and practitioners in rural areas have less access to patients and therefore have limited opportunities to learn tracheal intubation on human subjects. In Maine, the number of tracheal intubation attempts by personnel were well below published guidelines of 6-12 needed for skill maintenance (Burton, Baumann, Maoz, Bradshaw, & Lebrun, 2003). The operating room is the traditional location used by paramedic students for tracheal intubation opportunities; however, this is becoming

difficult with increased competition from other students and due to increased medical-legal concerns (Wang, Reitz, Hostler, & Yealy, 2005b). If there is any perceived difficulty in inserting the tracheal tube, due to patient history, pathology, or anatomy, the student is often prevented from intubating by the attending staff. This further diminishes the students' opportunity to acquire competency with airway management of patients likely to be encountered in the out-of-hospital environment.

Training for Professional Competence

The process of certification or licensure is the primary method utilized to verify competence in the health professions. Medical and dental schools, nursing and allied health programs, and post-graduate training programs prepare graduates for certification of competence by a variety of certification and licensing boards. There are many definitions of professional competence (Epstein & Hundert, 2002; Nolan, 1998; Peterson & Burns, 2005) but most contain elements of using knowledge appropriately and performing technical skills accurately. The NREMT examination verifies technical competence of tracheal intubation through the Practical Skill examination process on a mannequin or patient simulator. Students perform a series of steps to insert the tracheal tube while avoiding several critical errors and the attempt is scored by a human evaluator. Only one successful attempt is needed and there are no verification or minimum requirements for performance on a live patient during the students' training to pass this component of the NREMT examination. While the NREMT examination purports to identify entry level competence of EMTs, no formal study has shown if the

NREMT results predict future practice. Additionally, no researcher has identified if increasing the number of TIs during training impacts NREMT results.

For physicians, data support the assumption that licensing examinations predict future practice, but most are indirect. More knowledgeable physicians have more training (Ayanian et al., 1994; Edep, Shah, Tateo, & Massie, 1997), score higher on recertification examinations (Norcini, Lipner, Benson, & Webster, 1985), and achieve better patient outcomes (Jollis & DeLong, 1996). Tamblyn et al., (2002) discovered a more direct relationship between licensure examination scores taken at the end of medical school with indices of preventative care and acute and chronic disease management in primary care practice over 4 to 7 years. More objective measures of quality of care are lacking.

Issues of competency highlight the need to investigate the impact TI skill acquisition has on NREMT performance. Recommendations from the NSC suggest paramedic students perform five intubations prior to graduation. Those health professions that use TI define skill competency with higher numbers. Emergency medicine requires 35 TIs ("Accreditation Council for Graduate Medical Education: Emergency medicine-Guidelines for procedures and resuscitations."), anesthesiology up to 50 (Charuluxananan, Kyokong, Somboonviboon, & Pothimamaka, 2001), and nurse anesthetists 200 ("Standards for accreditation of nurse anesthesia educational programs," 2004). The five suggested in the NSC for EMT training contrasts with these higher numbers from other professions. The requirements are not only low for students but Wang, et al. (2005a) reinforced the competency question by reporting the lower

number of TIs by practicing paramedics. They examined the frequency of TI performance by out-of-hospital rescuers in Pennsylvania and found the median number of TIs performed by individual rescuers was one. Of 5,245 rescuers who reported performing TIs, 67% performed two or fewer TIs, and 39% of the rescuers did not perform any ETIs. They concluded that despite being an important resuscitation intervention, most rescuers rarely perform the skill in practice.

Adding to the issue, there are no TI requirements for NREMT recertification. Tracheal intubation is a complex procedural skill. The NREMT practical examination score sheet lists 27 separate steps for ventilation management which includes intubation of the trachea ("About NREMT Exams," 2005). Two findings from the nursing literature are germane to the investigation of paramedic education. In her seminal work on the development of expertise, Benner (1984) stated that novices and advanced beginners cannot recognize pertinent details or prioritize actions and they require deliberate guidance in clinical work. Secondly, the educational needs change as a student proceeds along the stages of skill acquisition (Daley, 1999).

While it is not expected that graduates be experts, evidence from other domains (sports, music, chess) strongly suggests that the acquisition of expertise requires sustained deliberate practice over at least 10 years (Ericsson, Krampe, & Tesch-Romer, 1993). While this is clearly beyond the time a paramedic student is in school, the issue of deliberate practice is an important one. Deliberate practice, according to Ericsson et al., includes the intention to improve performance, the engagement in activity that is sufficiently challenging, and the provision of immediate, informative feedback combined

with opportunities for application of this feedback by correcting errors. Returning to the issue of clinical instruction, these components of deliberate practice suggest that supervision should provide informative feedback while allowing independence to challenge the students' abilities. Performing the five tracheal intubations as suggested for paramedic training programs will not allow a student sufficient opportunities for deliberate practice as described by Ericsson and his colleagues.

Determining what is an appropriate number of tracheal intubations for students to perform in order to gain proficiency is problematic. Several investigators have observed the learning curve in skill acquisition. While it is recognized that students need sufficient opportunity to practice and use the skills of tracheal intubation, the optimal timing and nature of that experience is unclear (O'Connor, 2002). Additionally, when or how students reach their level of proficiency is not known. Several investigators have begun to develop quantitative measurements of intubation performance to assist in the assessment of proficiency. Lawler et al. used a graphical method of successes and failures and stated that 20 consecutive successful tracheal intubations might be the appropriate number for anesthetists (Lawler, Patla, Garcia, & Puttick, 1991). Konrad, Schupfer, Wietlisbach, and Gerber (1998), using a least square fit model and Monte Carlo procedures, demonstrated that after a mean of 57 attempts, a 90% success rate was achieved, but that even after 80 intubations, 18% of the residents needed assistance. Mulcaster et al. used statistical modeling to determine that there was a 90% probability of a good intubation after 47 attempts (Mulcaster et al., 2003). The CUSUM (CUMulative SUM) is a graphical tool useful for determining trend (Williams, Parry, &

Schlup, 1992). CUSUM alters with time (Altman & Royston, 1988), therefore it can illustrate progress in acquiring new skills and show proof of continued competence in the monitored task (Bolsin & Colson, 2000). Using CUSUM, de Oliveira & Rodrigues (2002) found acceptable failure rates of tracheal intubation after 43 attempts. Because CUSUM describes performance trends for individual subjects only, the researchers modeled success as the primary binary outcome and cumulative tracheal intubations as the independent variable. Their analysis was directed at how the skill of tracheal intubation improves with cumulative experience, not necessarily the minimum number of intubations to reach proficiency. Wang, Reitz, Hostler, and Yealy (2005b) used fixed-effects logistic regression to adjust for multiple relevant covariates and reported that paramedic students may require exposure to more than 15–25 live tracheal intubation encounters across a range of clinical settings to achieve success rates above 90%.

These varying statistical procedures all demonstrate several conclusions. First, tracheal intubation is a complex task and obtaining proficiency is difficult; there is also a need for objective measures to assess proficiency. Second, despite the variations in statistical procedures utilized in the studies, researchers have found that students must perform from 25 to 45 tracheal intubations to reach proficiency. These findings are significantly higher than the recommended five from the National Standard Paramedic Curriculum upon which the NREMT examination is based.

Situated Cognition

Traditionally, behaviorists' describe learning as something that happens inside one's brain and is separated from the context in which the learning occurs. Mayer (1996)

described the behavioral psychologists such as Watson and Thorndike as conceptualizing learning primarily as the acquisition and strengthening of responses. Wang and Katz (2007) described the cognitive complexities of tracheal intubation from a cognitive psychology perspective. They described Rasmussen's "Skill-Rules-Knowledge" model of cognitive control in skill performance, a model grounded in a teleological assumption of human behavior. This goal-directed behavior is related to tracheal intubation by the application of knowledge-based processing that is influenced by a practitioners' past experience and the dynamic context that creates the need for placement of a tracheal tube in a patient. It is the situative cues that modify a strictly rules-based approach to performing a tracheal intubation. There can be strict indications that a tracheal tube is needed for a patient; for example, a patient who is not breathing. But applying the same set of rules to a patient who is spontaneously breathing, appropriate actions are less clear. There are other clinical signs and symptoms that the clinician uses to decide if a tracheal tube is needed, for example the respiratory rate and level of consciousness. In this situation, the clinician may take a "wait and see" approach, waiting for more definite indicators for intubation. Understanding that the intubation is a process rather than a discrete skill impacts the teaching of this skill because educators must emphasize the contextual cues that influence a clinicians' decision making on the skill application. Even in the early 1900's, educators valued the role context plays in learning. Both Dewey (1916) and Lindeman (1926) identified the social environment and environmental situations as an important factor in adult education. The central role of the social context has gained importance in understanding

how adults learn (Hansman, 2001). Proponents of sociocultural models of learning describe learning as occurring not in the mind, as the behaviorist's models do, but as being shaped by the context and culture of the learning situation and the social interactions that place. When learning occurs in context, students or novices are often guided by experts through the complexities and intricacies of practice. From the perspective of situated cognition, learning is the process of entering a cultural meaning system (Brown et al., 1989). The clinical learning experience allows the student to develop autonomy and receive feedback from supervisors and from the milieu in which the learning is taking place. The concept of situated cognition demonstrates the social activity and orientation of learning. Wilson (1993) described cognition as a "social activity that incorporates the mind, the body, the activity, and the ingredients of the setting in a complex interaction and recursive manner" (p. 72).

Experience is central to learning. Lave and Wenger (1991) viewed learning as the process of entering into and becoming part of a community of practice. A community of practice refers to the process of social learning that takes places as people come together who share a common interest in problems and solutions, a common sharing and creating of tacit knowledge, and where social identity is created. Lave and Wenger focus on how peoples' interaction with the world allows learners access to knowledge that is inaccessible in traditional observational classroom settings. Paramedic students are required to work in clinical environments under varying levels of supervision prior to graduation from a program. By integrating themselves into the hospital environment by working alongside physicians, nurses, patients, and family members, students enter into

the medical culture. Paramedic students also are required to spend time on the ambulance working alongside other practicing paramedics, interacting with patients and the milieu of the ill-structured and unpredictable out-of-hospital environment. As paramedic students learn TI, they go from the lecture to the laboratory learning the skill on mannequins. Students may be asked to perform the skill in the operating room under physician supervision on patients prior to surgery or may encounter opportunities in the field during internships. Students learn from supervising physicians and paramedics during these opportunities but more importantly the student learns and performs in environments similar to those they will find in independent practice. This situated learning activity allows students to learn from other paramedics and health care professionals, observe outcomes of their interventions, and negotiate what is learned with the community of practice in which they are interacting. Learning is thinking, talking, and caring about new things in new ways modeled by members of the community of practice (Collins & et al., 1987).

Historically, tracheal intubation is a defining skill set of a paramedic and paramedic training. When paramedic education is framed in the theory of situated cognition, two contextual components are critical to the learning process. First, as reported above, the clinical environment is the social situation that becomes the source of a student's knowledge structure. Students are not just performing the tasks of paramedicine, they are actively engaged in a community of practice and learning flourishes not only because of student-teacher interactions but also due to the requirements of work. Second, based on Lave and Wenger (1991), in many situations,

apprentices learn mostly from other apprentices. Because medical and allied health education has relied on the clinical requirement to give students experience and proficiency in their basic skills, theories of situated cognition and cognitive apprenticeships spotlight the role of supervision and interaction of students with experts and practitioners in their learning environment.

Methodology

Design and Population

A questionnaire was developed to quantify paramedics' tracheal intubation experiences during training of all candidates attempting the NREMT-Paramedic written examination from January 1, 2006 through December 31, 2006. The research premise and questionnaire was approved by the National Registry of EMTs through a competitive application process and the question was placed at the end of the NREMT's paramedic written examination for voluntary response. Three primary data points were collected for analysis: overall score on the NREMT Paramedic Written examination; score on the Airway and Breathing section of the examination; and, self-reported responses to the approximate number of tracheal intubations performed during paramedic training. This also categorized intubations as live or only performed on mannequins. In addition, gender, age, education level, and ethnicity were recorded. Approval for the proposal was granted by the Institutional Review Boards of Texas A&M University and the University of Texas Health Science Center at San Antonio.

The NREMT-Paramedic written examination consists of 180 multiple-choice

questions over six separate topic areas (airway and breathing, cardiology, trauma, medicine, obstetrics and pediatrics, and EMS operations). The number of examination questions in each subtest range from 27 to 33. A total of 3917 individuals took the NREMT Written Paramedic Examination during 2006. As there was no mandatory requirement to furnish demographic information for the exam, a total of 1501 individuals were excluded from the analysis, including 1328 subjects who did not record their level of intubation experience, 147 subjects who did not record their education level, and 26 subjects who did not record their ethnicity. The sample for this study were the remaining 2416 subjects.

Data Analysis

Multivariable logistic regression using SPSS 15.0 was used to predict exam success using the demographic risk factors. Odds ratios with 95% confidence intervals that did not include 1 were considered significant. The diagnostic quality of the multivariable logistic regression model was assessed by computing predicted probabilities to produce a receiver operating characteristic (ROC) curve. The area under the ROC curve and associated 95% confidence interval was computed, and a predicted probability cut point was selected for which the sensitivity and specificity of the model were both significantly greater than 50%. Separate models predicted passing the overall exam (Figure 1) and scoring at least 70 on the airway portion (Figures 2 and 3). Reference categories for predictors were selected based on minimum exam pass rates. There were 7 classifications of intubation experience: none, 1 to 3, 4 to 6, 7 to 9, 10 to 12, 13 to 15, and 16 or more intubations performed.

Results

The exam passing rate for included subjects was 56.9%. Because it was possible to fail the overall examination despite receiving a passing score on the airway portion of the examination, a second examination outcome of a minimum score of 70 on the airway portion was recorded. Seventy was chosen because it was the overall median airway score, with 54.5% earning at least 70 on the airway portion, and because 80.9% who scored at least 70 on the airway portion passed the exam compared with only 57.3% who scored 63 to 69, which was virtually equivalent to the overall passing percentage.

Possible demographic risk factors for predicting passing collected at the time of examination were (1) level of intubation experience, (2) gender, (3) age, (4) education level and (5) ethnicity. The exam pass rate for the excluded subjects was 55.6%, which was similar to the 57.7% pass rate for included individuals. An airway portion score of at least 70 was earned by 53.8% of excluded subjects, similar to the 54.9% observed for included individuals. Gender distributions were virtually identical, with 75.1% male among excluded subjects and 75.2% male among included subjects. Excluded subjects tended to be older than included subjects. Among excluded subjects, 16.6% were aged 20 to 24 and 16.5% were aged 40 and older, while the corresponding percentages for included subjects were 22.4% aged 20 to 24 and 12.5% aged 40 and older. Education level distributions were similar, with 66.2% completing high school, 19.9% with associate's degrees and 13.9% with bachelor's degrees among excluded subjects, while included individual percentages were 65.0% for high school, 21.2% for associate's degrees and 13.9% for bachelor's degrees. The ethnicity distribution for excluded

subjects (81.3% white, 9.7% Hispanic, 6.4% black and 2.6% other) differed slightly from included subjects (86.5% white, 7.6% Hispanic, 3.0% black and 2.9% other). Percentage differences for the demographic risk factors were too small to warrant removal from the prediction model because of possible subject exclusion bias.

The lowest exam pass rate was 48.1% for those who had performed no tracheal intubations on live patients. Because the exam pass rates for 4 to 6 TIs (61.5%) and 7 to 9 TIs (60.8%) were virtually identical, these classifications were combined to form a single classification of 4 to 9 intubations performed with a pass rate of 61.2%. The pass rate by gender was 53.5% for females and 59.0% for males. Age was categorized as 20 to 24, 25 to 29, 30 to 34, 35 to 39, and 40 and over. The minimum exam pass rate was 51.3% for 35 to 39, slightly lower than the 52.5% pass rate for 40 and over. For ease of interpretation, age 40 and over was designated the reference category. Education level was classified as high school, associate's degree and bachelor's degree or higher. The minimum exam pass rate was 54.6% for the high school level. Ethnicity was represented as white, Hispanic, Black and other, with the lowest pass rate of 44.4% observed for African-Americans.

Factor	Other Group	Ref Group	Wald X2	df	p-value	Odds Ratio	95.0% C.I. for OR	
							Lower	Upper
Tracheal Intubations	1-3	None	2.71	1	0.0996	1.303	0.951	1.786
Tracheal Intubations	4-9	None	11.45	1	0.0007	1.663	1.239	2.233
Tracheal Intubations	10-12	None	2.53	1	0.1115	1.320	0.938	1.859
Tracheal Intubations	13-15	None	3.14	1	0.0762	1.471	0.960	2.253
Tracheal Intubations	16+	None	8.83	1	0.0030	1.763	1.213	2.563
Sex	Male	Female	5.41	1	0.0200	1.255	1.036	1.519
Age	20-24	40+	12.50	1	0.0004	1.698	1.266	2.276
Age	25-29	40+	3.94	1	0.0472	1.318	1.003	1.730
Age	30-34	40+	1.09	1	0.2973	1.172	0.869	1.581
Age	35-39	40+	0.09	1	0.7610	0.951	0.687	1.317
Education	Associates	HS	0.24	1	0.6243	1.053	0.857	1.292
Education	Bachelor+	HS	46.37	1	<0.0001	2.557	1.951	3.350
Ethnic	Hispanic	Black	0.58	1	0.4481	1.242	0.709	2.175
Ethnic	Other	Black	5.47	1	0.0194	2.326	1.146	4.720
Ethnic	White	Black	4.49	1	0.0342	1.688	1.040	2.740

Area Under the ROC Curve

Test Result Variable(s): Pred prob for Passing

Area	Std. Error	p-value	95% Conf Interval	
			Lower Bnd	Upper Bnd
0.611	0.011	<0.0001	0.589	0.634

a Under the nonparametric assumption

b Null hypothesis: true area = 0.5

Classification Table(a)

		Predicted		P	% Correct	95% Conf Interval	
Observed		Pass	Fail			Lower Bnd	Upper Bnd
Step 1	Pass_Fail	F	590	433	57.7	Specificity	54.6%
		P	594	799	57.4	Sensitivity	60.0%
Overall Percentage					57.5	Accuracy	55.5%
The cut value is .56							

Figure 1. *Logistic Regression Predicting Passing NREMTP Written Examination*

The resulting model predicting exam success (Figure 1) had reasonable goodness-of-fit by the Hosmer-Lemeshow test (Chi-square = 6.72, $p = 0.567$), and the area under the ROC curve defined by the model was 0.611 [95% c.i. = (0.589, 0.634)] indicating fair diagnostic quality for the model. Using a predicted probability of passing cutpoint of 0.56, the model had 57.4% sensitivity [95% c.i. = (54.7%, 60.0%)], 57.7% specificity [95% c.i. = (54.6%, 60.7%)], and 57.5% accuracy [95% c.i. = (55.5%, 59.5%)]. For intubation experience, significant odds ratios (relative to none performed) were observed for 4 to 9 performed [OR = 1.66, 95% c.i. = (1.24, 2.23)] and 16 or more performed [OR = 1.76, 95% c.i. = (1.21, 2.56)]. The male to female odds ratio [OR = 1.25, 95% c.i. = (1.04, 1.52)] was significant. For age category, significant odds ratios (relative to 40 and over) were observed for 20 to 24 [OR = 1.70, 95% c.i. = (1.27, 2.28)] and 25 to 29 [OR = 1.32, 95% c.i. = (1.00, 1.73)]. For education, the bachelor's degree to high school odds ratio [OR = 2.56, 95% c.i. = (1.95, 3.35)] was significant. For ethnicity, significant odds ratios (relative to African-Americans) were observed for whites [OR = 1.69, 95% c.i. = (1.04, 2.74)] and others [OR = 2.33, 95% c.i. = (1.15, 4.72)].

Factor	Other Group	Ref Group	Wald X2	df	p-value	Odds Ratio	95.0% C.I. for OR	
							Lower	Upper
Tracheal Intubations	1-3	None	3.14	1	0.0764	1.329	0.970	1.822
Tracheal Intubations	4-9	None	12.46	1	0.0004	1.699	1.266	2.280
Tracheal Intubations	10-12	None	2.36	1	0.1245	1.307	0.929	1.839
Tracheal Intubations	13-15	None	7.37	1	0.0066	1.808	1.179	2.772
Tracheal Intubations	16+	None	6.23	1	0.0126	1.601	1.106	2.317
Sex	Male	Female	18.90	1	<0.0001	1.524	1.260	1.842
Age	20-24	40+	0.90	1	0.3436	1.151	0.861	1.538
Age	25-29	40+	0.85	1	0.3558	1.137	0.866	1.492
Age	30-34	40+	0.02	1	0.8763	1.024	0.760	1.380
Age	35-39	40+	0.14	1	0.7105	0.940	0.679	1.302
Education	Associates	HS	0.02	1	0.8969	1.014	0.827	1.242
Education	Bachelor+	HS	38.92	1	<0.0001	2.299	1.770	2.987
Ethnic	Hispanic	Black	0.03	1	0.8728	1.047	0.600	1.827
Ethnic	Other	Black	2.00	1	0.1573	1.649	0.825	3.296
Ethnic	White	Black	0.99	1	0.3192	1.277	0.789	2.066

Area Under the ROC Curve

Test Result Variable(s): Pred prob for Passing

Area	Std. Error	p-value	95% Conf Interval	
			Lower Bnd	Upper Bnd
0.605	0.011	<0.0001	0.583	0.628

a Under the nonparametric assumption

b Null hypothesis: true area = 0.5

Classification Table(a)

		Predicted Airway70				95% Conf Interval	
Observed		< 70	70 +	% Correct		Lower Bnd	Upper Bnd
Step 1	Airway70 < 70	662	428	60.7	Specificity	57.8%	63.6%
	70 +	614	712	53.7	Sensitivity	51.0%	56.4%
Overall Percentage				56.9	Accuracy	54.9%	58.9%
The cut value is .55							

Figure 2. Logistic Regression Predicting Airway Score of 70 or Greater

When the same model (Figure 2) was used to predict an airway score of 70 or greater, the Hosmer-Lemeshow test (Chi-square = 2.00, $p = 0.981$) indicated a good fit for the model, and the area under the ROC curve defined by the model was 0.605 [95% c.i. = (0.583, 0.628)] indicating fair diagnostic quality for the model. Using a cutpoint of 0.55 for predicted probability of airway score of 70 or greater, the model had 53.7% sensitivity [95% c.i. = (51.0%, 56.4%)], 60.7% specificity [95% c.i. = (57.8%, 63.6%)], and 56.9% accuracy [95% c.i. = (54.9%, 58.9%)]. For intubation experience, significant odds ratios (relative to none performed) were observed for 4 to 9 performed [OR = 1.70, 95% c.i. = (1.27, 2.28)], 13 to 15 performed [OR = 1.81, 95% c.i. = (1.18, 2.77)], and 16 or more performed [OR = 1.60, 95% c.i. = (1.11, 2.32)]. The male to female odds ratio [OR = 1.52, 95% c.i. = (1.26, 1.84)] was significant. None of the age category odds ratios (relative to age 40 and over) were significant. For education, the bachelor's degree to high school odds ratio [OR = 2.30, 95% c.i. = (1.77, 2.99)] was significant. None of the ethnicity odds ratios (relative to African-Americans) were significant.

Factor	Other Group	Ref Group	Wald X2	df	p-value	Odds Ratio	95.0% C.I. for OR	
							Lower	Upper
Tracheal Intubations	1-3	None	3.29	1	0.0698	1.338	0.977	1.832
Tracheal Intubations	4-9	None	12.77	1	0.0004	1.707	1.273	2.290
Tracheal Intubations	10-12	None	2.36	1	0.1242	1.306	0.929	1.835
Tracheal Intubations	13-15	None	7.55	1	0.0060	1.816	1.187	2.778
Tracheal Intubations	16+	None	6.30	1	0.0121	1.601	1.109	2.313
Sex	Male	Female	19.40	1	<0.0001	1.529	1.266	1.847
Education	Associates	HS	0.01	1	0.9083	1.012	0.826	1.240
Education	Bachelor+	HS	38.52	1	<0.0001	2.265	1.749	2.932

Area Under the ROC Curve

Test Result Variable(s): Pred prob for Passing

Area	Std. Error	p-value	95% Conf Interval	
			Lower Bnd	Upper Bnd
0.605	0.011	<0.0001	0.582	0.627

a Under the nonparametric assumption

b Null hypothesis: true area = 0.5

Classification Table(a)

		Predicted Airway70				95% Conf Interval		
		Observed	< 70	70 +	% Correct		Lower Bnd	Upper Bnd
Step 1	Airway70	< 70	634	456	58.2	Specificity	55.2%	61.1%
		70 +	581	745	56.2	Sensitivity	53.5%	58.9%
Overall Percentage					57.1	Accuracy	55.1%	59.1%
The cut value is .55								

Figure 3. *Logistic Regression Predicting Airway Score of 70 or Greater with Exclusions*

Age and ethnicity were not associated with scoring 70 or better on the airway portion of the exam; therefore, the model was modified with these factors excluded, and similar diagnostic results were obtained (Figure 3). To further illustrate the diagnostic quality of the multivariable logistic regression model, results were used to identify groups of subjects with the lowest and highest probabilities of scoring at least a 70 on

the airway portion of the examination. The results indicated 4 to 9 intubations performed are the lowest experience level that outperformed the zero/none intubation category, males outperformed females, and those with bachelor's degree outperformed high school & associate's degree. The model is based on the assumption that the effects of intubation experience, sex, and education level are independent, so the probability of outcome is cumulative for these three factors. So females who reported fewer than 4 intubations performed and had not earned a bachelor's degree, were perceived as having the lowest probability of scoring at least a 70 on airway section, while males who reported at least 4 intubations performed and had earned a bachelor's degree, were perceived as having the highest probability of scoring at least a 70 on airway section. For the two subsamples that were selected: (1) 174 females who reported less than 4 intubations performed and who had earned at most an associate's degree and (2) 171 males who reported at least 4 intubations performed and who had earned a bachelor's degree. Group 1 had an exam passing rate of only 48.3%, while 74.9% of group 2 passed. Similarly, only 33.9% of group 1 scored 70 or better on the airway portion, while 70.8% of group 2 achieved an airway score of 70 or higher. These subgroup results are intended to be illustrative and are not necessarily to substantiate the logistic regression model.

Discussion

The survey provided a comparison of paramedic students' intubations performed on live patients during training and their success on the NREMT Paramedic Written Examination. The multivariable logistic regression model results suggest that the number of tracheal intubations, sex, ethnicity and education level are all associated with greater

odds of passing the certifying examination. Those reporting 4-6, 7-9, and greater 15 intubations during their training had greater odds of passing than those reporting none. Males had greater odds of passing than females. Individuals of Other and White ethnicity had greater odds of passing than African-Americans. Students reporting an educational level of bachelor's degree had greater odds of passing than those with a high school education.

Although this study demonstrates a weak statistical association between performing live intubations and success on the certifying examination, this could be due to the varied nature of "live" intubation experiences reported. This study did not differentiate between live intubation practice that occurred in a controlled operational suite under strict supervision by an anesthesiologist or a live intubation that can occur with near independence in the back of an ambulance or the small, cramped interior spaces of a crashed vehicle. Both of these can be reported as live attempts but the scenarios are different. When an intubation is performed in the operating room under direct supervision, the decision process regarding how the paramedic student reasons and formulates decisions is reduced. The decision to insert a tube based on a patients' presenting clinical signs and symptoms are removed. The student performs the task of TI on live patients, but ultimately, the operating room is not the actual context of paramedic practice. Several researchers report that the manner of out-of-hospital TI may be as important as TI success (Dunford, Davis, Ochs, Doney, & Hoyt, 2003; Hall et al., 2005; Katz & Falk, 2001). The varied, ill-structured, out-of-hospital setting is not the operating

room. At the intubation reporting range of 10-12, exam success was reduced. It is unclear if this is a reporting error due to the ease of recall of “ten” intubations.

Situated cognition holds that learning occurs while performing as a paramedic in realistic contexts. Experience creates knowledge. While EMS culture was not specifically investigated, the majority of paramedics are men. The analysis identified males had greater odds of passing than females. If learning occurs in context, the appropriateness, accuracy, and gender- and race-neutrality of that knowledge cannot be assumed to be present. Some learning can be detrimental. If a community of practice is dominated by one gender, one race, with corresponding expectations of behavior, language, and even thoughts, it can be assumed that the knowledge created may not be ethical, moral, or to other standards of acceptance and appropriateness. In other words, the community of practice could exclude those who do not “fit” the community. This raises important question that speak to the heart of EMS. Do male paramedics, either intentionally or not, exclude learning opportunities to woman coworkers and students? Is there a psychological orientation to the EMS profession that preferences one gender over another? Are learning opportunities in hospitals and ambulances minimized or even detrimental to one gender over another? Investigation cannot exclude the examination process itself. Why and how does gender influence the outcome of the NREMT Written Examination?

The findings in this investigation parallel others trends in education and similar to other studies reporting success on the national certifying examination (Dickison, Hostler, Platt, & Wang, 2006). Brown, Dickison, Misselbeck, and Levine (2002)

previously reported that students who did not complete high school were less likely to achieve a passing score on the national certification examinations than students who successfully completed their high school education, and male candidates were more successful than females. This current investigation shows that African-Americans are less likely to receive successful scores on the national certifying examination than other races.

Limitations and Further Questions

There are a number of limitations associated with self-reporting surveys. Respondents may not accurately recall the actual number of live tracheal intubations performed. Reported education level may not correlate with candidate intelligence.

Live intubations during training can show the subtleties of tracheal intubation on a wide range of patients and environments; however, the wide range of live intubation scenarios was investigated. Live intubation could occur in a controlled operating room with varying levels of assistance or they could occur with near independence in an uncontrolled out-of-hospital setting.

It is assumed that by performing live intubations, paramedic students are exposed to the authentic context of paramedic, out-of-hospital practice. Many live intubations occur in a hospital setting, which is significantly different from actual paramedic practice. Further studies are warranted to determine if learning from and with other health care professionals (physicians, nurses, respiratory therapists, etc) is similar to the learning that occurs strictly with other paramedics and EMTs in the out-of-hospital setting.

Additionally, determining the exact number of tracheal intubations needed to improve credentialing examinations scores was not investigated. The number of tracheal intubations reported in this study remains significantly below other professions' training requirements. The data collected and analyzed in this study, leads the researcher to conclude that there is a slight statistical association between performing live intubations during training and passing the NREMT-Paramedic written examination.

CHAPTER IV

FILLING A RESEARCH VOID IN EMERGENCY MEDICAL SERVICES WITH MIXED METHODS RESEARCH

Introduction

Emergency Medical Services is a system with little evidence of efficacy (Callaham, 1997) and national calls for increased research are being made (Cone, 2000; Sayre, White, & Brown, 2002). EMS is a profession in its adolescence and as such, issues of the professions epistemological standing are also young. Being a component to emergency medicine, EMS is shadowed by medicine's traditionally positivist worldview and its use of quantitative methodology. However, there is also the constructivist or phenomenological worldview which uses qualitative methods (Guba & Lincoln, 1994; Howe, 1988; Lincoln & Guba, 1985; Tashakkori & Teddlie, 1998). The research that has been done in EMS has followed the positive course, but EMS would be wise to also use a constructivist approach.

National calls for increased research into the practice of EMS and its outcomes will focus on evidence-based methods of research. Medicine elevates and promotes scientific, objective research to objectify phenomena. Randomized clinical trials remain a gold standard for medical research and the EMS National Research Agenda only lists all randomized clinical trials in EMS in its status report on prehospital research (Sayre et al., 2002). The aims of research in EMS are to improve the overall health of the community in cost effective ways, and to ensure the best patient care is provided (Sayre et al., 2002). But what research methods and designs best accomplish these aims? How

can evidence from large, randomized clinical trials lead to better care of the individual by a paramedic?

Two Paradigms

Worldviews or paradigms guide researchers' understanding of questioning and testing phenomena. The dominant research paradigm, particularly in the sciences, has been positivism/ postpositivism, but now the constructivist paradigm has gained legitimacy, especially in the social sciences and education. In understanding the concept of paradigms, Guba and Lincoln (1994) argue that it is necessary to consider the nature of reality (ontology), the relationship between the knower and the known (epistemology), and how knowledge is constructed (methodology). Kuhn (1962) defines a scientific paradigm as the *what* is to be observed, the *questions* to be asked, the *how* of structuring questions, and the *how* of interpreting results to scientific investigations. Positivism/postpositivism and constructivism conceptualize these elements differently. EMS researchers should value both paradigms, and although Carey (1993) writes that quantitative and qualitative techniques are merely tools to be utilized and combined to help answer questions, these tools should be used only after a critical review of their underlying assumptions.

The postpositivist paradigm uses quantitative methods to conduct research.. The scientific method is the foundation for all inquiry and all phenomena can be reduced to observed facts. The ontological position of the positivist states that there is one, objective truth existing independent of human perception. Quantitative advocates believe that social observations should be treated similarly as physical scientists treat physical

phenomena and that the observer remain separate from the entities being observed. Quantitative purists maintain that researchers should remove their biases, remain emotionally distant and uninvolved with the objects of study, and empirically justify their hypotheses (Johnson & Onwuegbuzie, 2004). The randomized clinical trial is synonymous with quality research for clinical studies. Quantitative studies are aligned to the medical practitioners' orientation to drawing conclusions from physical examinations using deductive reasoning, and the biomedical literature reflects this orientation with studies of epidemiologic investigations and clinical trails which aim to test specific hypothesis (Giacomini & Cook, 2000). The quantitative approach is characterized as an inquiry into a problem that tests a theory, is measured with numbers, and analyzed with statistical procedures to determine whether predictive generalizations hold true (Creswell, 1994). Quantitative research follows a scientific method that is deductive, meaning this approach applies general principles to reach specific conclusions. Research observations are made under controlled conditions, testing specific hypotheses. Quantitative researchers use questionnaires, laboratory equipment, rating scales, and other validated data collection instruments. This methodological framework includes test scores, attitude or behavior instruments, laboratory test results, medical diagnoses, number of ambulance calls in a 24-hour period, or number of patients surviving cardiac arrest. These data are statistically analyzed to test a hypothesis, answer research questions, or to measure and analyze causal relationships between variables in a value-free context (Denzin & Lincoln, 1994). Quantitative studies are often characterized by their large sample size to increase generalization, control variables, randomization of

subjects, structured protocols, and limited range of predetermined responses (Carey, 1993; Sale, Lohfeld, & Brazil, 2002). A fundamental component to quantitative research is the notion of variables. Variables are the component parts that are examined in a study. Quantitative variables vary in terms of amount, drug doses for example, and categorical variables vary in kind, such as heart rate being present or absent. The defining characteristic of quantitative research is the manipulation of variables or identifying correlations between variables.

The constructivist paradigm uses qualitative methodology to conduct research. The ontological position of the constructivist states there are multiple realities and multiple truths. Reality is socially constructed (Berger & Luckmann, 1966). According to Johnson and Onwuegbuzie (2004), qualitative purists reject the worldview of the postpositivist. Multiple-constructed realities exist, time-and context-free generalizations are not possible, and research is value-bound making differentiation between cause and effect impossible. The purpose of the qualitative approach is to seek understanding into human behavior. By focusing on questions such as *why* and *how*, this approach probes the reasons behind various aspects of human behavior. Qualitative research is naturalistic, interpretative, and seeks a deeper understanding of people's actions, decisions, beliefs, or values. Qualitative researchers seek to understand or describe a subject within context and within their social world; provide rich descriptions of reasons, associations, histories, and feelings; and provide interpretation of phenomena. Denzin and Lincoln (2003) define qualitative research as "a situated activity that locates the observer in the world. It consists of a set of interpretive, material practices that make the

world visible” (p. 4). Merriam (1998) describes five common characteristics of qualitative research. First, because there is a philosophical assumption that individuals construct reality based on interaction with the social world, researchers are interested in understanding the meaning that is being constructed. Second, when data is to be collected and analyzed, the research is the primary instrument. Third, most qualitative research involves fieldwork and be in the setting in order to observe. A fourth characteristic of qualitative research is its use of an inductive method. Where quantitative research tests theories, qualitative research builds concepts and hypotheses. The fifth characteristic, is the focus on a product of rich, descriptive words or pictures.

Validity is an importance concept in research, regardless of whether it is qualitative or quantitative. According to Creswell and Plano Clark (2007), in qualitative research validity speaks to the accuracy of the final report. This is accomplished through member-checks which is the process of taking the findings back to the participants for review. Validity is also increased by using multiple sources of information, increasing the amount of time in observation in the field, or using external reviewers to analyze the studies findings. Validity in quantitative research resides with the accumulated evidence that supports the intended interpretation of test scores for a proposed purpose. The initial question or hypothesis determines which data is to be gathered and how it is to be gathered. Unlike quantitative research, there is not a standardized test for qualitative research. Rather it is the research itself that guides the nature of the investigation and the validity is shaped by the representation of the participants and the appropriateness of the process used.

Qualitative methods pursue research questions that are not easily answered by experimental methods. Within health care, these methods can investigate questions such as attitudes of patients and practitioners, beliefs, and preferences, and how evidence transitions into practice (Green & Britten, 1998). In addition, questions dealing with why, how, contexts, and experiences can also be addressed with qualitative methods (McKibbin & Gadd, 2004). Qualitative research in health care can function in an interpretive role by probing social interactions. These findings offer insight into social, emotional, and experiential phenomena in health care (Giacomini & Cook, 2000).

Qualitative research is an inductive process seeking to gain a deeper understanding of a patient's experience. Qualitative research emphasizes meaning and experience, the relationship between the researcher and the researched, and the social construction of reality (Denzin & Lincoln, 2003). "Qualitative research is underpinned by the belief that there is no one truth, and thus consensus is neither necessarily achievable nor a necessary goal" (Johnson & Waterfield, 2004, p. 114). Qualitative studies allow evidence to be collected from a variety of settings and diverse populations. Qualitative research has a great potential to link health sciences and social sciences by describing the emotional, psychological, and social phenomena that influence the experience of health, illness, injury, and health care (Cook, Meade, & Perry, 2001). When researchers wanted to explore perceptions of antibiotic prescribing habits, a qualitative approach was used to generate hypotheses and to develop ideas for possible interventions (Walker, McGeer, Simor, Armstrong-Evans, & Loeb, 2000). Questions such as "How many out-of-hospital cardiac arrest patients survive to hospital

discharge?” or “What proportion of tracheal intubations incorrectly placed in the esophagus?” are answered through quantitative methods. But questions such as “Why do paramedics have difficulty with advanced airway procedures?” and “Why do students choose the EMS profession?” cannot be answered by researcher-generated problem-solving measurements. Researchers must listen to what the subjects have to say and describe the social and environmental context that frames their thoughts, feelings, and actions. “The strength of qualitative research lies in validity (closeness to the truth)—that is, good qualitative research, using a selection of data collection methods, really should touch the core of what is going on rather than just skimming the surface” (Greenhalgh & Taylor, 1997).

Qualitative research is often viewed by medical researchers as unscientific and anecdotal. This dominance of quantitative methods in conducting medical research has given rise to prioritizing statistical measures and mathematical tools. The strongest evidence for medical interventions is gained through experimental research: a systematic review of randomized, double-blind, placebo-controlled clinical trials. Because of the placebo effect, patient testimonials and case reports are not considered good evidence of efficacy or generalizability. A single, medical expert’s opinion serves little purpose and the priority is given to compiled and replicated scientific studies.

The dominance of quantitative research in medicine has given rise to evidence-based medicine. (EBM), the conscientious, explicit and judicious use of current best evidence in making decisions about the care of the individual patients. “It means integrating individual clinical expertise with best available external clinical evidence

from systematic research" (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996, p. 71). While qualitative studies elevate the individual voice of patient or practitioner, EBM's quantitative methodologies devalue these narratives. But health care cannot be created by the strict criteria that EBM alone promotes. Knowing what is best for the individual is best answered by a combination of scientific evidence from the general and the clinical expertise of the specific. While EBM is not a new approach to the delivery of health care (Straus & McAlister, 2000), there are debates as to the limits (or misperceptions) of EBM. These include: EBM denigrates clinical expertise (Charlton, 1997; Horwitz, 1996), it ignores patients values (Cohn, 1996), and EBM promotes a cookbook or application of scientific rules approach to medical practice (Charlton & Miles, 1998; Green & Britten, 1998; Horwitz, 1996). It is recognized that clinical experience requires personal observation, reflection, and judgment in order to care for individual patients (Freidson, 1988). These criticisms of EBM leave room in health care research for qualitative studies. The epistemological underpinnings of qualitative methods pursue research questions that are not easily answered by experimental, quantitative methods. Green and Britten (1998) report that qualitative methods can help bridge the gap between scientific evidence and clinical practice and qualitative research findings can provide rigorous accounts of treatment regimens in everyday context.

Nursing research has historically been the leader in health care in using qualitative research methodology (Giddings & Grant, 2007) and findings from qualitative research best critique the premise of EBM within medicine. Flemming (2007) explores the feasibility of combining qualitative research with randomized controlled

trials (RCTs) in evaluations of nursing practice. Her concern is that RCTs, which reflects a quantitative-positivist position, drive the research behind evidence-based healthcare and nursing. But evidenced-based nursing has been criticized on the reliance of RCTs because of a lack of relevance of RCTs to nursing practice. “Although RCTs may be central to the research base for nursing decisions, this does not sit comfortably with a profession that has traditionally drawn on multiple sources of knowledge, reflecting the eclectic nature of nursing practice” (Flemming, 2007, p. 42). Flemming’s point is that the evidence accumulating to provide evidence-based practice is done to reduce clinical uncertainty and this is best answered by RCTs ability to answer questions of effectiveness. But there are other types of questions that are important to nursing care, such as regarding how a treatment is perceived by those receiving it and this is best answered through qualitative measures. Although qualitative methods are valued in nursing, overall acceptance of qualitative research in the biomedical literature is still nominal. In the nursing field, McKibbin and Gadd (2004) conducted a descriptive survey to provide a quantitative evaluation of the qualitative studies published in 170 core clinical journals for 2000. They reviewed 60,330 articles; they found only 355 reports of original qualitative studies and 12 articles that systematically reviewed qualitative studies in specific areas, all of which appeared in 48 journals. Most of the journals were in the discipline of nursing. Only 4 of the most highly cited health care journals, based on ISI Science Citation Index (SCI) Impact Factors, published qualitative studies. Of the 355 original reports, 37 used both qualitative and quantitative (mixed) methods. I turn now to consider the value and benefit of such an approach.

Mixed Methods Approach

After looking at the extremes, a definition for mixed methods research emerges from the middle ground. Mixed methods research is an emerging process of research that offers ways to discover, test hypotheses, elicit multiple perspectives, illuminate findings, or to expand quantitative results. Creswell and Plano Clark (2007, p. 5) give this definition for mixed methods:

Mixed methods research is a research design with philosophical assumptions as well as methods of inquiry. As a methodology, it involves philosophical assumptions that guide the direction of the collection and analysis of data and the mixture of qualitative and quantitative approaches in many phases in the research process. As a method, it focuses on collections, analyzing, and mixing both quantitative and qualitative data in a single study or series of studies. Its central premise is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone (p. 5)

Mixed method research views both the numbers and the narratives, adding rigor to the process and results (Borkan, 2004). Stange (2004) writes that mixed methods assists in developing scientific objectivity while maintaining an understanding of context. Mixed method research “integrates quantitative methods that isolate a phenomenon from its context, with qualitative methods that emphasize meaning and an acquaintance with the particulars” (Stange, 2004, p. 4). Having this acquaintance with the particulars helps integrate the general, evidence-based scientific evidence with the

particular person or practice setting in which the evidence is being applied. When used in combination, quantitative and qualitative data yield more complete analyses, and complementarily capturing the trends and details of the situation (Creswell, Fetters, & Ivankova, 2004). Borkan (2004, p. 4) highlights the ability of quantitative data gathering methods' to isolate and identify correlates associated with variation at specific moments in time and qualitative techniques that gain insight into the processes and events that led up to the observed variation which provided unexpected insights.

This last point should be emphasized, because the nature of quantitative research and its data collection tools allow the researcher to infer only about that which he or she is examining (you "see" only what you are "looking at"), whereas qualitative methods can expand the gaze to key elements that were never elucidated or even previously considered (Borkan, 2004, p. 4).

There are reasons why mixing qualitative and quantitative studies is appropriate but it can be problematic. First, different paradigms represent different assumptions about knowledge and how to generate and analyze it and several authors highlight and discuss the deeper philosophical issues that these differing paradigms bring when attempting to combine them (Creswell, 1994; Guba & Lincoln, 1994; Smith & Heshusius, 1986). Foss and Bodil (2002) confirm that combining qualitative and quantitative methods is possible without violating separate paradigmatic assumptions. Because nursing practice, for example, is based on a diversity of knowledge, an epistemology is needed that reflects research into complex human responses from a variety of health care situations. "The various methods used should be recognized as

springing from different epistemological traditions which, when combined, add new perspectives to the phenomenon under investigation” (p. 242). Different types of knowledge are all equally valid and even necessary in order to more fully understand what is being investigated. There is also the technical problem of combining the two methodologies. Although there is mounting evidence of studies that do so, it is a technical challenge that methodologist should be able to resolve when combining the two (Morgan, 1998). Despite the difficulties, mixed methods research has been increasingly used beginning with Campbell and Fiske’s (1959) study of the validation of psychological traits in 1959. Today there are at least 10 mixed methods textbooks published, plus several journals and websites that are specific to mixed methods research (Hanson, Creswell, Clark, Petska, & Creswell, 2005).

Mixed methods research is being labeled as the third wave or third methodological research movement (Giddings & Grant, 2007; Johnson & Onwuegbuzie, 2004). Mixed methods research allows researchers to answer their questions from multiple approaches without restricting their choices. Researchers should strive to use methods that follow research questions in a way that offers the best opportunity for useful answers to be discovered. “Many research questions and combinations of questions are best and most fully answered through mixed research solutions” (Johnson & Onwuegbuzie, 2004, p. 18).

Sale, Lohfeld, and Brazil (2002) give three viewpoints as to why qualitative and quantitative methods can be combined. First, quantitative and qualitative approaches can be combined because they share a common goal of understanding the world. Rules of

inference are the same between them. Second, as methodologies they are compatible “because they share the tenets of theory-ladenness of facts, fallibility of knowledge, indetermination of theory by fact, and value-laden inquiry process” (p. 46). Both methods share the common goal of collecting and disseminating knowledge while maintaining rigor required of scholarly activities. Third, the complexity of some phenomena requires multiple methods of investigation and collection of a wide variety of data

Sale, Lohfeld, and Brazil (2002) work to reconcile the problems inherent in combining research methodology that is said to be incommensurate. They state that qualitative and quantitative researchers do not study the same phenomena, but these can be combined in a single study if it is done for complementary purposes. Their example of studying nurse burnout illustrates how phenomena in mixed methods research can be labeled. A mixed methods study to develop a measure of job burnout experienced by nurses could be described as a qualitative study of the lived experiences of burnout to inform a quantitative measure of burnout.

A mixed-methods study to develop a measure of burnout experienced by nurses could be described as a qualitative study of the lived experience of burnout to inform a quantitative measure of burnout. Although the phenomenon ‘burnout’ may appear the same across methods, the distinction between “lived experience” and “measure” reconciles the phenomenon to its respective method and paradigm (Sale, Lohfeld, & Brazil, 2002, p. 50).

There are a variety of motivations for combining qualitative and quantitative methods. In a systematic review of the literature on combining qualitative and quantitative methods. Green, Caracelli, and Graham (1989) discuss the importance of distinguishing between motivations for combining the different methods and the specific research designs to meet these goals. In reviewing 57 mixed method evaluation studies from 1980 to 1988, five purposes or justifications were identified:

1. Triangulation: The intent of this design seeks convergence, corroboration, and correspondence of results from different methods.
2. Complementarity: The intent of this design seeks elaboration, enhancement, illustration, clarification of the results from one method with results from the other method. An example is a “qualitative interview to measure the nature and level of program participants’ educational aspirations, combined with a quantitative questionnaire to measure the nature, level, and perceived ranking within peer group of participants educational aspirations” (1989, p. 258).
3. Development: The intent of this design “seeks to use the results from one method to help develop or inform the other method, where development is broadly construed to include sampling and implementation, as well as measurement decisions” (1989, p. 259).
4. Initiation: The intent of this design “seeks the discovery of paradox and contradiction, new perspectives of frameworks, the recasting of questions or results from one method with questions or results from the other method” (1989, p. 259).
5. Expansion: The intent of this design seeks to extend the breadth and scope by using different methods for different inquiry components.

Denzin's (1978) work on triangulation formed the basis for combining methods that were aimed at confirming results. It takes considerable effort to conduct studies with the goal of convergent findings and fewer studies are conducted for this reason (Morgan, 1998). But researchers have sought alternatives to the time-consuming process of convergence, and complementarity has been the most popular reason for combining qualitative and quantitative methods. "The key goal in studies that pursue complementarity is to use the strengths of one method to enhance the performance of the other method" (Morgan, 1998, p. 356). Triangulation is popular within the nursing field but Sandelowski (1995) writes that this has become overused and should be used only when convergent and consensual validity are valued. Having the resources and expertise needed to combine qualitative and quantitative methods is an important practical question to consider. The key issue to whether a mixed methods project is appropriate lies in the end result: Does the end project become more than the sum of the individual qualitative and quantitative parts?

In an analysis of 232 social science articles, Bryman (1992) examined the ways that qualitative and quantitative research is combined in practice. He reviewed a ten-year period of journal articles several fields: sociology; social psychology; human, social and cultural geography; management and organizational behavior; and media and cultural studies. These articles were chosen in terms of data collection and data analysis and then the content was analyzed in relation to these aspects of the research process. The major contributing discipline was sociology with 36 percent of all articles followed by social psychology (27%); management and organizational behavior (23%); geography (8%);

and media and cultural studies (7%). In terms of research methods, 82 percent of all articles used a survey instrument, 57 percent of all articles were based on a combination of a survey instrument and qualitative interviewing. In terms of research design, the most common design was a cross-sectional design (63%) collecting both qualitative and quantitative data. According to Bryman, when researchers use multi-strategy research, outcomes are less predictable with new insights uncovered and new directions discovered.

[Q]uantitative research is by no means a mechanical application of neutral tools that results in no new insights. In quantitative data analysis, the imaginative application of techniques can result in new understandings. If the two are conducted in tandem, the potential – and perhaps the likelihood – of unanticipated outcomes is multiplied. (Bryman, 1992, p. 111)

The Potential of Mixed Methods in EMS Research

Within social and behavioral sciences, most major areas of research use multiple methods: “Since the fifties, the social sciences have grown tremendously, and with that growth there is now virtually no major problem-area that is studied exclusively within one method” (Brewer & Hunter, 1989, p. 22). Mixed methods research holds the same potential for sound investigations into the practice and outcomes of prehospital care. Health researchers are particularly interested in combining qualitative and quantitative methods likely due to the complex nature and variety of factors which influence health. In addition, increased methodological rigor (Barbour, 2001; Johnson & Waterfield, 2004; Morgan, 1998) and a broader acceptance of qualitative methodologies in a

predominately quantitative field (Giacomini & Cook, 2000; Mays & Pope, 1995) have allowed mixed methods research to gain acceptance. In the EMS literature, however, there is a dearth of qualitative studies investigating issues pertaining to paramedics. Two studies investigated paramedics' perceptions of administering pre-hospital thrombolytics through focus group interviews (Cox, Albarran, Quinn, & Shears, 2006; Price, Keeling, Brown, Hughes, & Barton, 2005). Jones and Machen (2003) explored paramedics' perceptions of patients in pain and the paramedics' perspective of pre-hospital pain management. Thomas, Abo, and Wang (2007) used focus groups and individual interviews to investigate paramedics' perceptions of challenges encountered in performing tracheal intubation in the out-of-hospital setting. All four of these qualitative studies recognized deficiencies in the literature regarding paramedics' perceptions on critical issues of paramedic practice where the findings were used to further illuminate areas of investigation. In a specific review of EMS research articles published in *Prehospital Emergency Care*, from 2001 to 2007 very few articles using qualitative methodology were discovered. Bond, Kostenbader, and McCarthy (2001) investigated the level of acceptance of a human patient simulator as a training tool. Their closed-response survey included three open-ended responses and responses were gathered based on themes in the responses. The written comments were separated into positive and negative categories regarding the use of a human simulator. The only mixed methods research was preliminary investigation to develop a clinical decision rule to assist out-of-hospital providers in caring for older patients in respiratory distress (Shapiro, Rosenfeld, Daya, Larson, & McCauley, 2005). This study included a qualitative component to list

possible clinical indicators of severe respiratory distress, a Delphi survey to identify the ten best from among that list, and a retrospective chart review to assess the feasibility of gathering data on the clinical indicators from the out-of-hospital medical record and a measure of severe respiratory distress from ED medical records. The qualitative component involved a researcher who rode along with a sample of EMS providers to observe their care of patients in respiratory distress. The investigator spent more than 100 hours observing and interviewing paramedics. In order to begin developing specific clinical indicators, the investigator asked paramedics during interviews to describe how they could tell when older patients in respiratory distress were “really sick,” what parameters did they assess, and how did they interpret the results of their assessments. The qualitative component in this study allowed investigators to determine what signs and symptoms paramedics relied on as key indicators of severe distress. This allowed a greater depth of response that was tied to direct observation and field notes by the investigator.

Despite the deficiency of this research within EMS, there are four convincing reasons mixed methods research may be used: 1) mixed methods can be used to better understand a research problem by converging numeric trends from quantitative data and details from qualitative data; 2) mixed methods helps identify variables that may be measured through the use of existing instruments or the development of new ones; 3) mixed methods can may be used to obtain statistical, quantitative data and results from a sample of a population and use them to identify individuals who may expand on the results through qualitative data and results; and 4) it may be used to convey the needs of

individuals or groups of individuals who are marginalized or underrepresented (Hanson et al., 2005; Mertens, 2003; Punch, 1998).

Mixed Method Design

Creswell and Plano Clark (2007) distill four major types of mixed methods designs from over 40 reported in the *Handbook of Mixed Methods in Social and Behavioral Research* (Tashakkori & Teddlie, 2003). These are the Triangulation Design, the Embedded Design, the Explanatory Design, and the Exploratory Design.

The Triangulation Design (See Figure 4) is the most common and is used to bring together the strengths and nonoverlapping weaknesses of quantitative and qualitative methods. It is used to compare and contrast quantitative statistical results with qualitative findings. The researcher looks for patterns of convergence to develop an overall interpretation of findings (Mays & Pope, 2000). Although this is the most common form of mixed methods research in the literature, it does present some challenges. Because equal weight is often given to both types of data, expertise is needed in its gathering, analysis, and reporting. Another problem is knowing what to do when the results do not agree, which would require collecting additional data or a reexamination of the existing data.

Baskerville, Hogg, and Lemelin's (2001) process evaluation of an outreach facilitation intervention to document the extent to which the intervention was implemented is an example of a triangulation design. Twenty-two intervention practices with a total of 54 physicians participated in a randomized controlled trial that took place in Canada. The key measures of process were the frequency and time involved to deliver

intervention components, the scope of the delivery and the utility of the components, and physician satisfaction with the intervention. Content analysis of the physician interviews and bivariate analysis of physician self-reported changes between intervention and control group physicians revealed that the audit and feedback, consensus building, and development of reminder systems were the key intervention components. By using data collection tools to evaluate the implementation of the intervention, and a combination of descriptive, quantitative, and qualitative analyses, a triangulation process was used to obtain a more complete understanding of the quality of implementation.

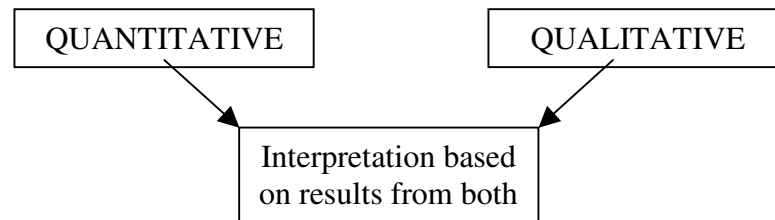


Figure 4. *Triangulation Design*. Source Creswell and Plano Clark (2007)

The Embedded Design is one in which one data set provides support and is secondary to the other type of data (see Figure 5). Here a single data set is not enough and different questions require different data. Typically this occurs when a qualitative component is needed within a quantitative design. Qualitative and quantitative data are both collected but one of the types supplements the research design. This design has the advantage of being used when a researcher does not have the time or resources to fully commit to extensive quantitative and qualitative data collection and it is more

manageable because one method requires less data than the other. Challenges of this design include: the researcher needs to specify the purpose of collecting one source of data while minimizing another; and, integrating results are difficult or more specifically, the intent is not to integrate the results. The study by McIlvain, Backer, Crabtree, and Lacy (2002) illustrates this design. In this study, the researchers used a cross-sectional design using qualitative and quantitative analyses to explore family physicians' attitudes about smoking cessation counseling—its importance, their confidence in their ability to counsel, outcome expectations of counseling, perception of their influence on patient behavior, types of counseling skills used, and the extent to which office based activities were used to support their counseling. Data, including information from participant observation of the environment, medical chart reviews, and in-depth interviews, were collected from 89 physicians. Their findings raised questions about how to teach resident physicians to maintain their motivation to address smoking cessation counseling.

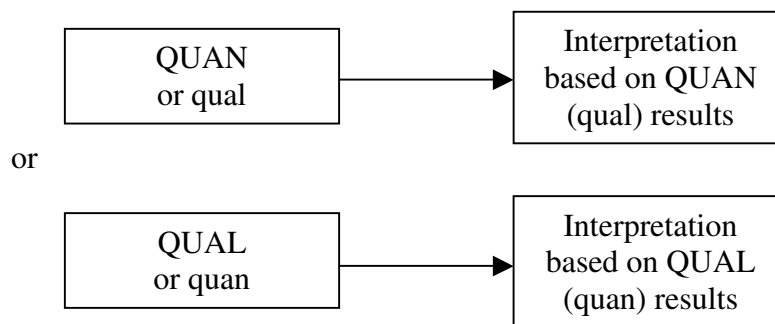


Figure 5. *Embedded Design*. Source Creswell and Plano Clark (2007)

The Explanatory Design is a two-phase design with the purpose of using qualitative data to explain or add to quantitative results (see Figure 6). This design is beneficial when qualitative data are needed to explain statistically significant or surprising results. This design allow a final report to be written in two, straightforward phases and is well suited to the quantitative researcher due to its strong orientation to quantitative methods and data. Despite it being straightforward, the design requires a lengthy amount of time to implement the two phases and researchers must decide whether to use the same individuals for both phases. For an example from the nursing field, Borkan, Quirk, and Sullivan (1991) integrated qualitative ethnographic data and quantitative epidemiological data to determine predictors of recovery after hip fracture in elderly patients. Predictors such as age, type of break, and comorbidity were collected by using standard questionnaires. In-depth interviews collected narratives focusing on internal explanations of the fracture, sense of disability, and view of the future after hip fracture. None of the epidemiology factors predicted successful outcomes but those who perceived their fracture as more external or mechanical as opposed to being related to chronic disease were more likely to have good recovery. Persons whose perception of their disability was consistent with more autonomy, independence, and connection with the outside world also showed better ambulation at 3 and 6 months than persons with a more narrow and confined view of the fracture and its resulting disability. Another example of an Explanatory Model is found in Schillaci, et. al. (2004) article that explores the reasons for a dramatic fall in immunization rates among New Mexico's children.

When the investigators were performing an assessment of Medicaid managed care using quantitative data from the National Immunization Survey and employing several statistical tests, it was discovered that immunization rates for children declined significantly to the lowest levels in the United States. The research team responded by analyzing qualitative data found in their ethnographic data files for material on immunization and then partially redirecting ongoing ethnographic observations during the remaining years of the study. These researchers capitalized on the mixed methods process of reanalyzing data, noticing the unexpected, and returning to data sources for qualitative inquiry. When a statistical trend was discovered of decreased immunizations, the researchers turned to the why and used interviews and observations to uncover potential explanations. Through their ethnographic findings, the researchers suggested that a reduction in funding to state-run public health clinics, in conjunction with increased informal referrals by private physicians and managed care organizations, might have contributed to the decreased immunization coverage.

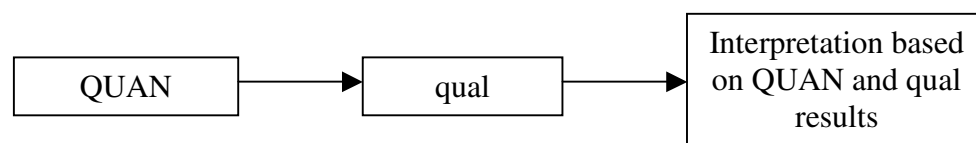


Figure 6. *Explanatory Design*. Source Creswell and Plano Clark (2007)

The Exploratory Design (see Figure 7) is used when the qualitative method is first and the results help develop or inform the secondary quantitative method. This method is used when it is necessary to explore phenomena because there are no

measures or instruments available or the variable are unknown. The advantages and disadvantages are similar to the Explanatory Design but with the added advantage of having more appeal to quantitative-orientated readers or reviewers. It is also called the Instrument Design Model (Creswell, Fetter, & Ivankova, 2004) because it begins with qualitative data collection and analysis and moves to quantitative instrument design and testing. One example of the exploratory design is the study by Kutner, Steiner, Corbett, Jahnigen, and Barton (1999) that sought to describe the issues important to terminally ill patients receiving palliative care and to determine whether patient characteristics influence the needs of these patients. They first conducted interviews with 22 terminally ill individuals, and then used these data to develop a structured instrument which was administered to a second population of 56 terminally ill patients. The researchers concluded that though a mixed method design, they found that their subjects have needs and concerns which reflect both disease- and illness-related themes. This will allow health care providers to be more aware of the diversity of needs and concerns of the terminally ill.

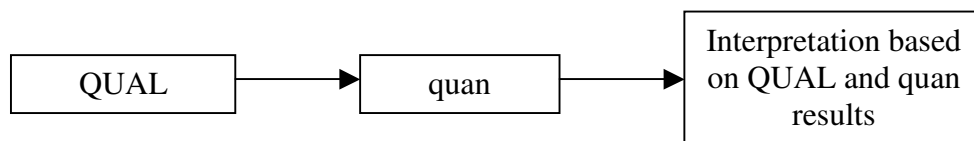


Figure 7. *Exploratory Design*. Source Creswell and Plano Clark (2007)

Creswell and Plano Clark (2007) conclude their descriptions of the four designs by discussing how to select a type of mixed methods designs.

What are the key factors that researchers should consider when choosing a mixed methods design for their studies? Researchers should consider the research problem that they want to study. A primary consideration is that the design should match the research problem. In addition, researchers should evaluate their own expertise and consider the quantitative and qualitative skills that they possess. (p. 79)

Future Directions and Questions for Mixed Methods Research

Mixed methods research is expanding into many disciplines and is considered the third methodological movement. This movement is the natural extension of the expanded use of qualitative research in health care investigations. Mixed method research is more than just collecting quantitative and qualitative data. These studies represent data that will be integrated, related, or mixed at some stage of the research process because when used in combination, both quantitative and qualitative data yield a more complete analysis and assist in answering multifaceted question in the dynamic milieu of health care (Creswell et al., 2004). Within the domain of healthcare, primary care and nursing are leading the movement but there are calls of advocacy in emergency medicine. Goodacre (2003) described situations where qualitative methods are valuable and can assist emergency medicine researchers to answer pragmatic and policy-related questions. He recognized that qualitative methodology may be unfamiliar to the quantitatively oriented researchers of emergency medicine. But questions, for example,

such as understanding how to reduce the time delay before patients with symptoms of a stroke or myocardial infarction seek medical help, are oriented to a qualitative research approach. Although EMS is significantly absent from the scene, it can take the cue from these other medical professions. Mixed methods provides an ideal design for answering today's complex health care questions, which require attention to quantitative 'numbers' and qualitative 'narratives'. As the EMS profession should consider mixed methods, Creswell and Plano Clark (2007) highlight emerging questions that novice and experienced professions should be prepared to answer in the near future. They identify key areas in which further work is needed in the mixed methods research arena. In mixed methods designs and procedures, issues of sampling leave concerns. What should the sample sizes be for the quantitative and qualitative pieces of a mixed methods study? Should they include the same participants? Should there be randomization? These issues of different sampling methods will assist researchers in specific design variants. Mixed methods researchers will benefit from data analysis software programs that combine quantitative and qualitative data. Several programs now exist that are combining these forms of data but more is needed to go beyond statistical tests and qualitative coding. In addition to sampling and software issues, researchers need to know the structures for writing up mixed methods results that adapt to the guidelines of funding proposals and journals.

The second area involves mixed methods designs and worldviews. These designs currently have been used rarely involving theoretical perspectives such as feminism, race, gender, or postmodern and emancipatory assumptions. As previously discussed, the

theoretical lens refers to the philosophical paradigm of a researcher's study and methodology. But if a researcher brings implicit assumptions to the investigation, researchers must decide whether they are viewing their study from a paradigmatic base such as an advocacy-based lens, like feminism (Hanson, Creswell, Plano Clark, Petska, & Creswell, 2005). Methodology is influenced by the theoretical lens employed. "If ... a feminist lens is used in a mixed methods study, then the gendered perspective provides a deductive lens that informs the research questions asked at the beginning of the study and the advocacy outcomes advanced at the end (Hanson et al., 2005, p. 227).

The third area questions the implications and value of using mixed methods. Does using mixed methods add value to a study? How is the value seen by researchers and practitioners? Is it worth the time and effort to conduct mixed methods? Mixed methods may require more resources, more training of researchers, and a new demand on funding agencies, institution review boards, and consumers of the research. Is it worth it?

For advocates of mixed methods research and in particular those who are advocates for the qualitative/constructivist perspective, another issue arises. Will mixed methods be considered a permissible, but less valuable approach than positivist enquiry? Giddings and Grant (2007) expose this concern by stating that mixed methods research "passes for an alternative methodological movement that purports to breach the divide between qualitative and quantitative research, most mixed methods studies favor the forms of analysis and truth finding associated with positivism" (2007, p. 52). The danger

is that research moves away from exploring the philosophical questions or engaging in modes of enquiry that challenge the status quo.

Ideologically, mixed methods covers for the continuing hegemony of positivism, albeit in its more moderate, postpositivist form. If naively interpreted, mixed methods could become the preferred approach in the teaching and doing of research. Rather than the promotion of more co-operative and complex designs for increasingly complex social and health issues, economic and administrative pressures may lead to demands for the ‘quick fix’ that mixed methods appears to offer (Giddings, 2006, p. 195).

Mixed Methods in Existing EMS Research

EMS is a health profession but it plays a role in a variety of other settings: public health, public safety, primary care, military, public services, private industry, and homeland security, to name a few. When investigating EMS, these divergent domains require a wide net of data collection and analysis and a broad spectrum of qualitative and quantitative methods. How specifically could a mixed methods approach add value to EMS research? In order to answer this question, three recently published articles in *Prehospital Emergency Care* were evaluated for their focus on EMS clinical or education issues and their quantitative focus. Then applying a mixed methods research design model, these identified studies were hypothetically redesigned to make the study a mixed methods design to identify potential increased insight or richness of the studies primary findings and conclusions.

Paramedics practice under unique and sometimes dangerous conditions. When accident scenes involve hazardous materials, rescuers respond in personal protective equipment (PPE) and are at risk from environmental and exposure-related illnesses such as heat stroke or exhaustion. These rescuers require rapid cooling and hydration. The first study reviewed investigated time differences in obtaining fluid resuscitation through intravenous or interosseous (needle inserted into bone) routes wearing or not wearing PPE by rescuer and simulated patients (Suyama, Knutsen, Northington, Hahn, & Hostler, 2007). The results compared time differences with the matched scenarios but by interviewing the rescuers, the investigators use of an Explanatory Design could add further insight. A shorter time to fluid resuscitation is clinically important. But rescuers' descriptions of the ease or difficulty of using equipment, especially with an invasive bone needle insertion, could make the use of this method difficult or impractical despite its quicker time to insertion. Or perhaps rescuers could describe issues or problems of manual dexterity in cumbersome protective suits that could further enhance the value of one method over another.

There are a variety of products used to control a patient's airway. In a study to investigate which airway device has the shortest time to successful ventilation, it was found that the Laryngeal Mask Airway (LMA) resulted in faster times over other products (Hoyle, Jones, Deibel, Lock, & Reischman, 2007). This investigation can be redesigned into an Embedded Design where one data set provides support and is secondary to the other data. For example, the data set could include the original datum of time to insertion, but it would be valuable to have additional data regarding existing

familiarity and expectations of individual products and descriptions of encountered problems during the insertion of the airway device; these data would provide new insights into how to train paramedics on new devices.

Finally in my own research investigating relationships between the number of tracheal intubations and scores on the national certification examination, a qualitative component could add insight into the cultural component of paramedic education. Just as there are several devices for controlling a patient's airway, there are different ways students learn the procedures. Students can learn the procedural steps from lectures and textbooks and visualize the steps to insert a tracheal tube. Students can practice on mannequins in classroom settings gaining the physical dexterity and manipulation required for successful inserting. Additionally, there are more technologically sophisticated and anatomically realistic mannequins that can better reflect real life situations. Third, students can learn through cognitive apprenticeships with other paramedics in the field in authentic emergency situations. The situated learning that occurs takes into account not only the "real" patient but also the interaction that occurs between new paramedic, co-workers, nurses, physicians, family members, and environment. The coordination between all these various factors creates knowledge for the new paramedic who learns to act, speak, and think like other paramedics. By interviewing new paramedics who learned tracheal intubation through these various stages, I could gain more insight into how these experiences guide the learning process. I can gain a deeper description of what the paramedic culture is to that student who is on the periphery of a profession and working towards the center of acceptance and

understanding. Some paramedic students may not have access to hospitals where tracheal intubation practice can occur. What impacts the learning process for these paramedic students who primarily gain proficiency by mannequin practice and limited exposure to authentic contexts of paramedic practice? How do these students who become paramedics describe their first tracheal intubation in the field? How does this compare to those students who were exposed to these experiences earlier as students? All these questions can illuminate and extend the quantitative results from this study. By providing words in addition to the numbers, I can broaden my lens of investigation and elucidate my discussions and conclusions.

Conclusion

As a profession, emergency medical services will gain from any and all forms of research it generates. The void is too great. But filling the void with standard and traditional scholarship is an incomplete solution. Emerging researchers must attend to internal and external theoretical/paradigmatic issues. This grinds the lens that informs the investigation and proffers the type of data gathered and analyzed. Because mixed methods research demands a working knowledge of quantitative and qualitative methods, researchers will need additional training as well as be called to work in teams to distribute expertise (Hanson et al., 2005). Mixed methods research is a legitimate research design that has huge potential in bringing together qualitative and quantitative methods in creative and integrated manners. EMS researchers have a wide horizon of method and methodology now at their disposal and we should heed the words of Strange and Zyzanski (1989):

If the only tool researchers have is a hammer, they tend to see every problem as a nail. An appreciation of both quantitative and qualitative approaches can enhance a researcher's ability to answer complex questions in a manner which is efficient, internally valid, and generalizable. (p. 451)

CHAPTER V

CONCLUSION

EMS education is emerging from past constraints and entering a new era created from societal and regulatory demands for quality and accountability. At the core of this transformation is the proverbial definitional debate of whether this field is a trade or a profession. In 1966, Congress passed the Allied Health Personnel Training Act (P.L. 89-751) in response to the increasingly specialized need for medical technologists. Allied health programs began establishing specialized educational accreditation models similar to those of nursing and medical schools. This created an educational infrastructure for most allied health programs that were similar to nursing and medical schools, placing these newly created programs in institutes of higher education with trained faculty and investments in national accreditation and credentialing systems.

Also in 1966, a paper published by the National Academy of Science National Research Council titled *Accidental Death and Disability: The Neglected Disease of Modern Society* charted a unique course for the development of EMS. This paper provided considerable funding for the development of EMS in the United States, but it also turned EMS down a path of development and integration into the workforce that is very different from other allied health professions. The National Academy of Sciences paper reported that there were no generally accepted standards for ambulance attendants and recommended that a standard course of instruction be created. In 1969, the Highway Safety Bureau (now the National Highway Traffic Safety Administration, NHTSA) contracted the development of a standardized ambulance attendant curriculum and it was

not until 1977 that the first EMT-Paramedic National Standard Curriculum (NSC) was developed. In contrast to other allied health professions, a federal government agency became the de facto source for standards of EMS education and many states created administrative rules and scopes of practice from the NSC throughout the 1970s to 1990s.

In the mid-1990s, NHTSA began a project to develop a strategic plan and needs assessment to guide the future development of EMS. The *EMS Agenda for the Future* (National Highway Traffic Safety Administration, 2000) was developed as a guide for EMS providers, health care organizations and institutions, government agencies, and policy makers. This document called for EMS to expand beyond an emergency response system into a larger public health role. One recommendation to support this new role called for changes to the EMS educational infrastructure, including an expansion of accreditation, affiliation of higher level EMS education with academic institutions, replacing the NSC with “core content” and national education standards, and national level EMS certification (Margolis, 2007). Based on the history of EMS, national trends, and my own experiences, I describe three recommendations for change and then conclude with future research possibilities.

First, link national certification eligibility to graduation from an accredited institution. The history of the growth of EMS demonstrates that despite a federally created curriculum, the education process has been localized, decentralized, and unregulated. Most professions limit eligibility of entering the credentialing process to graduates from accredited programs. Program accreditation is designed to create learning environments that are monitored, reviewed, and accountable. In addition, accreditation

standards work to implement or regulate national educational standards. Accreditation status empowers educational institutions to work with stakeholders, hospitals, EMS agencies, and health care professionals to help implement accreditation standards. For example, if there is an accreditation standard for paramedic students to perform live intubations, the EMS training program alone may not be able to work with hospitals and surgical staffs to gain access to learning opportunities, thus jeopardizing accreditation. But having the EMS training programs' dean, vice president, or president work with hospitals lends more power and perhaps credibility to the relationship and interaction. Losing accreditation status would prevent a school from enrolling and graduating students.

The second recommendation is to increase the role of higher education in EMS. EMS education takes place in a variety of settings. A significant portion takes place in an academy setting by local municipalities, such as fire departments. Community colleges, technical schools, hospitals, private proprietary training institutions, as well as colleges and universities offer EMS training programs. While quality can vary across all these entities, only colleges and universities can offer formal recognition in terms of degrees or college credit. An associate's degree should be recognized as the minimum level of paramedic education preparation. Academic institutions have the faculty and staff support, student services, financial aid, infrastructure, and stability necessary to provide quality outcomes. In parallel with the nursing profession, EMS education should also provide bachelor's and master's degree level education preparation. Currently, the Consortium of Academic Programs in EMS lists 15 institutions that offer bachelor's

degrees in EMS (<http://www.capems.org>). Unfortunately, due to the relative youth of EMS as well as current health care reimbursement models, there is no consistent acceptance of the value of obtaining these degrees.

The third recommendation is to teach the practice of paramedicine within context. A large portion of paramedic training occurs in hospitals. Students spend time observing in emergency rooms, operating rooms, and in psychiatric and obstetric departments. While this is considered training, it actually only represents exposure to emergency medical care and not true practice. Paramedic practice is first and foremost medical care outside the hospital. Paramedic training does include clinical training on an ambulance but some still occurs in the hospital. Context is key. Educators must continue to create learning opportunities that most accurately reflect the actual practice of paramedicine. This means that paramedic students must be exposed to the community of practice in increasing levels of participation and develop cognitive apprenticeships during paramedic training. Learning activities should involve the six components or techniques of cognitive apprenticeships: modeling, coaching, scaffolding, articulation, reflection, and exploration. Through this, the knowledge of experts can be passed on by situating the knowledge in authentic contexts. Because of the importance of context to learning, the skill of tracheal intubation should be learned on live patients in authentic environments. EMS educational administrators should continue to work with medical colleagues to gain access to operating rooms and surgical patients. These colleagues should continue to assist EMS students in learning and training without unnecessary fears of liability. It has now been demonstrated that learning TI not only prepares

students for real-life application, the knowledge gained extends beyond just skill acquisition. When students learn in environments in which they will practice, there is a reciprocal relationship between student and community of practice. The community imparts its knowledge to students and the students learn from the milieu of authentic paramedic practice.

Recommendations for Future Research

The history of EMS research is short and therefore our knowledge base is limited. Further research is needed in both paramedic education and in clinical practice. The results of this study suggest that additional research be conducted in several areas. For example, it has been demonstrated that performing more live intubations during training leads to higher passing rates on the certification exam. What is not known is why this occurs. A qualitative study of paramedics in their first 3-5 years of practice should be conducted in order to understand how what they learned about TI in their training using live patients prepared them for performing TIs in their practice.

This study raises important questions regarding the paramedic culture. Is the paramedic culture discriminatory or detrimental to the learning of women and some minorities? What is the actual community of practice as voiced by the experiences of individual paramedics? To answer this question an ethnographic study that would uncover the culture of EMS educational practice, as well as the culture of actual EMS practice, is needed.

Allied health programs that have successfully transformed themselves have often done so through improvement of their educational systems. Practitioners can demand

better salaries, improved work environments, and increased opportunities for advancement. But these demands will not be met without change and improvement by the practitioners through improved education and training. The demand for higher salaries do not come without risk, sacrifice, and self-improvement. Education is the catalyst for change and growth of the EMS profession. Adult learning theories, particularly theories of situated learning, experiential learning, communities of practice, and cognitive apprenticeships, offer great promise for the improvement of EMS education, improved patient outcomes, and ultimately for realizing the new vision for EMS service to our communities.

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